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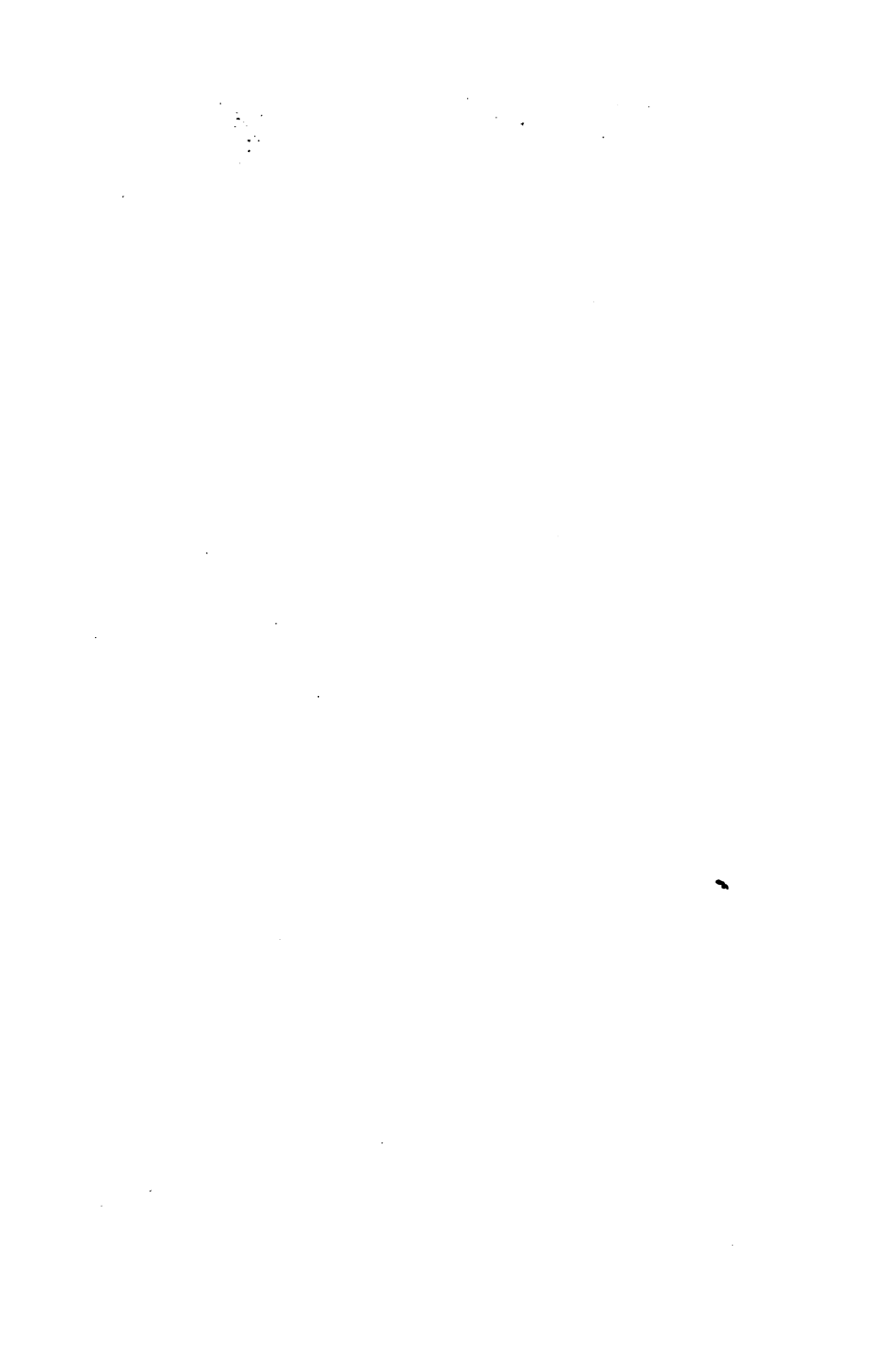


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A K E Y

to THE

CIVIL SERVICE ARITHMETIC.

LONDON: PRINTED BY
SPOTTISWOODE AND CO., NEW-STREET SQUARE
AND PARLIAMENT STREET

A KEY
TO THE
CIVIL SERVICE ARITHMETIC.

CONTAINING
CONCISE SOLUTIONS OF ALL
THE DIFFICULT QUESTIONS PROPOSED BY THE
CIVIL SERVICE EXAMINERS

BY ROBERT JOHNSTON.



LONDON:
LONGMANS, GREEN, AND CO.
1868.

181. g 36



K E Y

TO THE.

CIVIL SERVICE ARITHMETIC.

THERE is really no question requiring solution until we arrive at

VI. page 26.

(10) 365) 389455 (1067 *Ans.*

$$\begin{array}{r} 365 \\ \underline{2445} \\ 2190 \\ \underline{2555} \\ 2555 \\ \underline{} \end{array}$$

(20) From 25*s.*

Take 3*s.*

2) 22*s.*

11*s.* share of the one

and $11 + 3 = 14*s.*$ „ the other

VII. page 29.

(1) 15 *guineas*

21

15

30

315 *shillings*

12

3780 *pence*

4

15120 *farthings*

(2) See Ex. 3, p. 29.

(3) and (4). See Ex. 2, p. 28.

(5) See Ex. 3, p. 29.

(6) (7) and (8). See Ex. 2, p. 28.

(9) and (10). See Ex. 3, p. 29.

$$\begin{array}{r}
 (11) \quad 159 \text{ quarters} \\
 \quad \quad 8 \\
 \hline
 1272 \text{ bushels} \\
 \quad \quad 4 \\
 \hline
 5088 \text{ pecks} \\
 \quad \quad 2 \\
 \hline
 10176 \text{ gallons} \\
 \quad \quad 4 \\
 \hline
 40704 \text{ quarts}
 \end{array}$$

$$\begin{array}{r}
 (12) \quad 34 \text{ lbs. 10 oz. 12 dwts} \\
 \quad \quad 12 \quad \quad \quad [16 \text{ grs}] \\
 \hline
 418 \text{ oz.} \\
 \quad \quad 20 \\
 \hline
 8372 \text{ dwts.} \\
 \quad \quad 6 \\
 \hline
 50232 \\
 \quad \quad 4 \\
 \hline
 200944 \text{ grs.}
 \end{array}$$

$$\begin{array}{r}
 (13) \quad 3 \text{ ac. 20 rods 12 sq. yds.} \\
 \quad \quad 4 \quad \quad \quad [7 \text{ sq. ft.}] \\
 \hline
 12 \text{ roods} \\
 \quad \quad 40 \\
 \hline
 500 \text{ rods} \\
 \quad \quad 30\frac{1}{2} \\
 \hline
 15012 \\
 \quad \quad 125 \\
 \hline
 15137 \text{ sq. yards} \\
 \quad \quad 9 \\
 \hline
 136240 \text{ sq. feet}
 \end{array}$$

(16) See Ex. 3, p. 29.

$$\begin{array}{r}
 (17) \quad 3 \text{ wks. 4 days 5 hrs. 54} \\
 \quad \quad 7 \\
 \hline
 25 \\
 \quad \quad 12 \\
 \hline
 300 \\
 \quad \quad 2 \\
 \hline
 605 \text{ hrs.} \\
 \quad \quad 60 \\
 \hline
 36354' \\
 \quad \quad 60 \\
 \hline
 2181240'' \text{ Ans.}
 \end{array}$$

(14) and (15). See (12), above.

$$\begin{array}{r}
 (18) \quad 13 \text{ yds. 7 ft. 19 in.} \\
 \quad \quad 9 \\
 \hline
 124 \text{ feet} \\
 \quad \quad 12 \\
 \hline
 1488 \\
 \quad \quad 12 \\
 \hline
 17875 \text{ in. Ans.}
 \end{array}$$

(21) See (12), above.

(22) See Ex. 2, p. 28.

(23) See Ex. 1, p. 28.

(24) See (12), above.

(19) See (18), above.

(25) See Ex. 2, p. 28.

(20) See Ex. 3, p. 29.

(26) See Ex. 1, p. 28.

(27) 375 cwt. 2 qrs. 1 st. 13 lbs.

$$\begin{array}{r}
 4 \\
 \hline
 1502 \text{ qrs.} \\
 2 \\
 \hline
 3005 \text{ stones} \\
 14 \\
 \hline
 42083 \text{ lbs.} \\
 16 \\
 \hline
 673328 \text{ oz.}
 \end{array}$$

(28) See Ex. 3, p. 29.

(29) See (12), above.

(30) 42 wks. $8\frac{1}{2}$ hrs. $15\frac{1}{2}' 5''$

$$\begin{array}{r}
 7 \\
 \hline
 294 \text{ days} \\
 2 \quad 24 = 2 \times 12 \\
 \hline
 588 \\
 12 \\
 \hline
 7064\frac{1}{2} \text{ hrs.} \\
 60 \\
 \hline
 423855 \\
 \frac{1}{2} \text{ of } 60 = \frac{15\frac{1}{2}}{60} \\
 \hline
 423870\frac{1}{2}' \\
 60 \\
 \hline
 25432235''
 \end{array}$$

(31) See (17), above.

VIII. page 32.

(1) See Ex. 1, p. 31.

(2) See Ex. 2, p. 31.

(3) 4) 523769 grs.

$$\begin{array}{r}
 6) 130942..1 \\
 2,0) 2182,3..4 \\
 12) 1091..3
 \end{array}
 \left. \vphantom{\begin{array}{r} 6) 130942..1 \\ 2,0) 2182,3..4 \\ 12) 1091..3 \end{array}} \right\} 17$$

90 lbs. 11 oz. 3 dwts. 17 grs.

$$\begin{array}{r}
 (4) \quad 9) 569705 \text{ sq. ft.} \\
 \underline{63300} \text{ .. } 5 \\
 30\frac{1}{4} \quad \underline{4} \\
 \underline{4} \\
 121 \left\{ \begin{array}{l} 11) 253200 \\ 11) 23018 \text{ .. } 2 \\ 4,0) 209,2 \text{ .. } 6 \end{array} \right\} \frac{68}{4} = 17 \\
 \underline{4) 52 \text{ .. } 12} \\
 13 \text{ ac. } 12 \text{ pls. } 17 \text{ yds. } 5 \text{ ft.}
 \end{array}$$

$$\begin{array}{r}
 (5) \quad 6,0) 2933693,5'' \\
 \underline{6,0) 48894,8 \text{ .. } 55} \\
 24 \left\{ \begin{array}{l} 6) 8149 \\ 4) 1358 \text{ .. } 1 \\ 7) 339 \text{ .. } 2 \end{array} \right\} 13 \\
 48 \text{ wks. } 3 \text{ days } 13 \text{ hrs. } 8 \text{ m. } 55''
 \end{array}$$

(6) See (3), above.

$$\begin{array}{r}
 (7) \quad 12) 348164 \text{ in.} \\
 \underline{3) 29013 \text{ .. } 8} \\
 9671 \\
 \underline{2} \\
 11) 19342 \\
 \underline{4,0) 1758} \quad \frac{4}{3} = 2 \text{ yds.} \\
 \underline{8) 43 \text{ .. } 38} \\
 5 \text{ mls. } 3 \text{ fur. } 38 \text{ pls. } 2 \text{ yds. } 8 \text{ in.}
 \end{array}$$

(8) See Ex. 2, p. 31.

(12) See (4), above.

(9) See (5), above.

(13) See (3), above.

(10) See Ex. 3, p. 31.

(14) See Ex. 2, p. 31.

(11) 12) 150000

(15) See (7), above.

$$\begin{array}{r}
 12) 12500 \text{ doz.} \\
 \underline{1041} \text{ gross } 8 \text{ doz.}
 \end{array}$$

- (16) 12) 247391 in. (17) See (3), above.

$$\begin{array}{r} 3) 20615 \text{ .. } 11 \\ \hline 6871 \text{ .. } 2 \\ \hline 2 \end{array}$$

11) 13742 half-yds.

$$\begin{array}{r} 4,0) 124,9 \quad \frac{3}{2} = 1 \text{ yd. } 1 \text{ ft. } 6 \text{ in. } \} \\ 8) 31 \text{ .. } 9 \quad \quad \quad 2 \quad 11 \quad \} \end{array}$$

3 mls. 7 fur. 9 pls. 2 yds. 1 ft. 5 in.

- (18) 12) 657918 c. in.

$$\begin{array}{r} 12) 54826 \text{ .. } 6 \quad \} \\ 12) 4568 \text{ .. } 10 \quad \} \quad 126 \} \\ 3) 380 \text{ .. } 8 \times 144 = 1152 \} \\ 9) 126 \text{ .. } 2 \quad \quad \quad 1278 \} \end{array}$$

14 yds. 2 ft. 1278 in.

- (19) See (18), above. (20) See (16), above.

- (21) See Ex. 2, p. 31. (22) See (18), above.

(23) Number of *fourpenny pieces* = $37689 \times 3 = 113067$.

- (24) See (23), above.

(25) Number of *half sovs.* = $\frac{7642 \times 21}{10} = 16048$ and 2s.

(26) Number of nls. = $564 \times 5 \times 4 = 11280$.

- (27) See Ex. 1, p. 33.

$$\begin{array}{r} (28) \quad 3) 250 \\ 2,0) 8,3 \quad 4 \\ \hline \quad \quad \pounds 4 \quad 3 \quad 4 \\ \quad \quad \quad 14 \quad 3 \\ \hline \quad \quad \pounds 4 \quad 17 \quad 7 \text{ Ans.} \end{array} \quad \begin{array}{r} 4) 57 \\ \hline 14s. 3d. \end{array}$$

$$(29) \text{ Number of labourers} = \frac{35 \times 21}{2\frac{1}{2}} = \frac{35 \times 21 \times 2}{5} = 294 \text{ Ans.}$$

XIII. DUODECIMALS, page 58.

$$\begin{array}{r}
 (1) \quad \begin{array}{r} 21 \text{ ft.} \quad 7' \quad 6'' \\ 19 \quad 5 \end{array} \\
 \hline
 \begin{array}{r} 410 \quad 10 \quad 6 \\ 9 \quad 0 \quad 1 \end{array} \quad \begin{array}{l} \text{product by } 19 \\ \text{" " } 5' \end{array} \\
 \hline
 9) 419 \text{ ft.} \quad 10' \quad 7'' \quad 6''' \\
 \quad \quad \quad 12 \\
 \hline
 \text{Yds. } 46 \text{ ft. } 127\frac{1}{2} \text{ in. Ans.}
 \end{array}$$

$$\begin{array}{r}
 (2) \quad \begin{array}{r} 36 \text{ ft.} \quad 9' \\ 24 \quad 10 \end{array} \\
 \hline
 \begin{array}{r} 882 \quad 0 \\ 30 \quad 7 \end{array} \quad \begin{array}{l} \\ 6'' \end{array} \\
 \hline
 9) 912 \quad 7' \quad 6'' \\
 \quad \quad \quad 12 \\
 \hline
 \text{Yds. } 101 \text{ ft. } 90 \text{ in.}
 \end{array}$$

(3) $17 \times 17 \times 17 = 4913$ cubic inches, the content of the cube,
 $= 2$ cubic feet 1457 inches.

(4) See (2), above.

$$\begin{array}{r}
 (5) \quad \begin{array}{r} 36 \text{ ft. } 9 \text{ in.} \\ 12 \end{array} \quad \begin{array}{r} 101 \text{ yds. } 3 \text{ ft. } 90 \text{ in.} \\ 9 \end{array} \\
 \hline
 441 \quad 912 \text{ ft.} \\
 \quad \quad \quad 12 \\
 \hline
 10944 \\
 \quad \quad \quad 12 \\
 \hline
 441) 131418 \\
 \quad 49) 14607 \\
 \quad \quad 7) 2086 \\
 \quad \quad \quad 1 \quad 298 \text{ in.} = 24 \text{ ft. } 10 \text{ in. Ans.}
 \end{array}$$

(6) 39·37

$$\begin{array}{r} 2 \\ \hline 78\cdot74 \text{ one edge; } \therefore 78\cdot74 \times 78\cdot74 \times 78\cdot74 \\ \hline 27 \times 1728 \\ \hline 864 \\ 432 \end{array}$$

$$= \frac{6102337\cdot7953}{11664} = 282 \text{ c. ft. } 891\cdot023624 \text{ c. in.}$$

(7)

$$\begin{array}{r} 7 \text{ ft. } 5' \quad 8' \\ \hline 9 \quad 4 \quad 11 \\ \hline 67 \quad 3 \quad 0 \\ 2 \quad 5 \quad 10 \quad 8''' \\ \hline 6 \quad 10 \quad 2 \quad 4'''' \\ \hline 70 \quad 3' \quad 8'' \quad 10''' \quad 4'''' \\ 12 \quad \quad \quad 12 \\ \hline 843 \quad \quad \quad 124 \\ 12 \quad \quad \quad 144 = 3\frac{1}{2} \\ \hline 10124\frac{31}{8} \text{ sq. in.} \end{array}$$

(9)

$$\begin{array}{r} 2 \text{ ft. } 7' \quad 11'' \\ \hline 3 \quad 5 \quad 7 \\ \hline 7 \quad 11 \quad 9 \\ 1 \quad 1 \quad 3 \quad 7''' \\ \hline 1 \quad 6 \quad 7 \quad 5'''' \\ \hline \text{Sq. ft. } 9 \quad 2' \quad 7'' \quad 2''' \quad 5'''' \end{array}$$

The first figure 9 is square feet;
the second 2' is = 2 twelfths
of a square foot, = 24 sq. in.;
7'' is = 7 sq. in.; 2''' is = $1\frac{1}{2}$
or $\frac{1}{8}$ of a sq. in.; and 5'''' is
= $\frac{5}{144}$ of a sq. in.

(10) See (1), above.

XIV. MISCELLANEOUS EXERCISES, page 58.

(1) Sum he receives = £7 4s. 3d. $\times 52 \times 2 =$ £750 2s.

$$\begin{array}{r} 2 \\ \hline 14 \quad 8 \quad 6 \text{ in } \quad 2 \text{ weeks} \\ \hline 13 \\ \hline 187 \quad 10 \quad 6 \text{ in } \quad 26 \quad , \\ \hline 4 \\ \hline \text{£}750 \quad 2 \quad 0 \text{ in } \quad 104 \quad , \end{array}$$

$$(2) \quad \frac{1}{4}d. = \frac{1}{48} \text{ of } 1s. \quad \begin{array}{r} 313s. 0d. \text{ at } 1s. \text{ per day.} \\ 6 \quad 6\frac{1}{4} \text{ at } \frac{1}{4}d. \text{ ,, ,,} \\ \hline 2,0 \quad 30,6 \quad 5\frac{3}{4} \\ \hline \pounds 15 \quad 6 \quad 5\frac{3}{4} \text{ Ans.} \end{array}$$

$$(3) \quad \frac{20s. - 5s.}{6} = \frac{15}{\frac{6}{2}} = 2s. \quad 6d. \text{ Ans.}$$

$$(4) \quad \begin{array}{r} \pounds 1000 \quad 0s. \quad 0d. \\ 982 \quad 14 \quad 0\frac{1}{4} \\ \hline 17 \quad 5 \quad 11\frac{3}{4} \\ 8 \\ \hline 138 \quad 7 \quad 10 \\ 7 \\ \hline 968 \quad 14 \quad 10 \\ 17 \quad 5 \quad 11\frac{3}{4} \\ \hline \pounds 986 \quad 0 \quad 9\frac{3}{4} \text{ Ans.} \end{array}$$

(5) See (20), p. 27.

$$(6) \quad \text{Ans.} = \frac{\pounds 16 \quad 10s. \quad 9d. \times 4\frac{1}{2}}{13\frac{1}{2}} = \frac{\pounds 5 \quad 10s. \quad 3d.}{\frac{16 \quad 10 \quad 9 \times 9 \times 7}{3}}$$

(7) See (27), p. 30.

(8) See Ex. 5, p. 52.

(9) See Ex. 1, p. 43.

(10) and (11). See Ex. 5, p. 51.

(12) See p. 51, Ex. 3.

(13) See p. 33, Ex. 1.

$$(14) \quad \begin{array}{r} \text{tons} \quad \text{cwt.} \quad \text{qrs.} \quad \text{lbs.} \\ 347 \quad 13 \quad 2 \quad 23 \\ 89 \quad 15 \quad 3 \quad 25 \\ 8) 307 \quad 17 \quad 2 \quad 26 \\ 7) 38 \quad 9 \quad 2 \quad 20 \quad 8 \quad 6 \\ 5 \quad 9 \quad 3 \quad 23 \quad 7 \text{ oz. } 6\frac{48}{56} \text{ drs.} \\ 7 \end{array}$$

$$(15) \text{ Income} = 4s. 6d. \times 365 + \pounds 2 \ 6s. 10\frac{1}{2}d. \times 12 = \pounds 110 \ 5s.$$

$$(16) \text{ Salary} = \frac{\pounds 17 \ 10s.}{14d.} = \frac{4200}{14} = \pounds 300.$$

$$(17) \frac{60 \times 5}{15} = 20 \text{ Ans.}$$

$$(18) \frac{30 \times 9\frac{1}{2}}{8} = \frac{1410}{4} = 352\frac{1}{2} \text{ lbs.} = 25 \text{ st. } 2\frac{1}{2} \text{ lbs.}$$

$$(19) \text{ See Ex. 1, p. 33, in Treatise.}$$

$$(20) \frac{\pounds 26 \ 12s.}{10s. \ 8d.} = \frac{1596}{128} = 49\frac{1}{2} \text{ yds.}$$

$$(21) \text{ Cost of 30 perches} = 20 \times 6\frac{1}{2}d. = 10s. \ 10d.$$

$$\therefore \begin{array}{rcl} \text{10} & & 3 \ 7\frac{1}{2} \\ \hline 40 & = & 14 \ 5\frac{1}{2} \\ [12 \times 40 = 480] & & 12 \end{array}$$

$$3 \text{ ac.} = 3 \times 40 \times 4 = 480 \text{ pls. } \pounds 8 \ 13 \ 4 \text{ Ans.}$$

$$(22) \text{ See (5), above.}$$

$$(23) \text{ See Ex. 1, p. 34.}$$

$$(24) \text{ See (13), p. 30.}$$

$$(25) 3 \times 3 \times 8 \times 40 \times 5\frac{1}{2} \times 3 \times 12 = 570240 \text{ in. Ans.}$$

$$(26) \text{ See Ex. 1, p. 28.}$$

$$(27) \text{ See Ex. 2, p. 28.}$$

$$(28) \quad 15s. \ 6\frac{3}{4}d. \text{ price of 1 yd.}$$

$$\begin{array}{rcl} & 6 \ 4 \ 6 & \text{,, ,, 8 yds.} \\ & \hline & 4 & \\ & 24 \ 18 \ 0 & \text{,, ,, 32 ,,} \\ & \hline \frac{1}{2} \text{ of } 15s. \ 6\frac{3}{4}d. = & 7 \ 9\frac{3}{8} & \text{,, ,, } \frac{1}{2} \text{ yd.} \\ & \hline & \pounds 25 \ 5 \ 9\frac{3}{8} & \text{Ans.} \end{array}$$

(29) and (30). See p. 47, Examples 4 and 5.

(31) See Ex. 3, p. 29.

(32) See Ex. 2, p. 43.

(33) See Measure of Capacity, p. 25. (34) See (22), above.

(35) He rows 7 miles an hour with stream
Rate of stream $2\frac{1}{2}$ miles an hour

∴ He can row $4\frac{1}{2}$ " " on still water
Stream $2\frac{1}{2}$

Against it 2 miles per hour

Hence, it appears that the rate of rowing with the stream exceeds the rate against it by *twice* the rate of the stream.

(36) $8 \times 3s. 6d. = 28s. 0d.$

$10 \times 3 \quad 8 = 36 \quad 8$

$12 \times 4 \quad 2 = 50 \quad 0$

$10 \times 4 \quad 6 = 45 \quad 0$

$\frac{159 \quad 8 \text{ buying price}}{40 \times 4 \quad 8 = 186 \quad 8 \text{ selling price}}$
 $27s. 0d. \text{ gain}$

(37) See Ex. 1, p. 56.

(38) See *Answer*.

(39) $\frac{198 \times 1760}{3\frac{1}{2}} = \frac{198 \times 1760 \times 4}{13} = 107224\frac{8}{13} \text{ Ans.}$

(40) See (18), p. 32.

(41) See (13), p. 30.

(42) See (16), p. 32.

(43) See (3), p. 32.

(44) See Ex. 3, p. 29.

(45) See Ex. 2, p. 31.

(46) $441 \times 4 = 1764 = 4 \text{ times height of lower}$
 126

$1890 = \text{half difference}$

2

3780 difference

441 lower one

4221 higher

- (47) If we double the hour of the sun's rising we get the length of the night; if we double the hour of his setting we get the length of the day. Hence, 24 hrs. — 3 hrs. 49' 51" $\times 2$ = 16 hrs. 20' 18".

(48) See Ex. 2, p. 28.

(49) See (16), p. 32.

(50) See (48), above.

(51) See (35), above.

(52) See (16), p. 32.

$$(53) \text{ Circumference of wheel} = \frac{3\frac{1}{2} \times \cancel{1760}^{\cancel{160}}}{\cancel{1848}^{\cancel{168}}_{21}} = \frac{7 \times \cancel{20}^{\cancel{10}}}{\cancel{21}^{\cancel{3}}_1} = 3 \text{ yds. 1 ft.}$$

(54) See Ex. 3, p. 29.

(56) See Ex. 3, p. 29.

(55) 12) 767914 sq. in.

(57) See Ex. 2, p. 28.

$$\begin{array}{r} 12 \overline{) 68992} \dots 10 \\ 9 \overline{) 5332} \dots 8 \end{array} \left. \vphantom{\begin{array}{r} 12 \overline{) 68992} \dots 10 \\ 9 \overline{) 5332} \dots 8 \end{array}} \right\} 106$$

(58) See (12), p. 29.

$$\begin{array}{l} 592 \text{ sq. yds. 4 ft.} \\ [106 \text{ in.} \end{array}$$

(59) See Ex. 2, p. 31.

(60) 13 c. yds. 5 ft. 19 in.

(61) See Ex. 3, p. 29.

27

96

26

356 ft.

12

4272

12

51264

12

615187 cub. inches.

(62)

oz.	dwt.	grs.
1	13	8
		3

5 0 0

90

12) 450 oz.

37½ lbs.

(63) See (16), p. 32.

(64) See Ex. 1, p. 33.

(65) See (12), p. 29.

(66) See Ex. 2, p. 28.

(67) See (16), p. 32.

(68) See Ex. 2, p. 31.

(69) See Ex. 2, p. 31.

(70) See (5), p. 32.

XV. VULGAR FRACTIONS.

No difficulty can present itself in the solution of the first 16 under this head.

$$(17) \quad \frac{72}{168} = \frac{6}{14} = \frac{3}{7}$$

$$\frac{48}{180} = \frac{6}{20} = \frac{3}{10}$$

$$\frac{272}{1456} = \frac{34}{187} = \frac{2}{11}$$

(18) to (20). See (17), above.

(21) Resolve into prime factors—

2) 7040	2) 7392
2) 3520	2) 3696
2) 1760	2) 1848
2) 880	2) 924
2) 440	2) 462
2) 220	3) 231
2) 110	7) 77
5) 55	11
11	

$$\therefore \frac{7040}{7392} = \frac{\cancel{2} \times \cancel{2} \times \cancel{2} \times \cancel{2} \times \cancel{2} \times 2 \times 2 \times 5 \times 11}{\cancel{2} \times \cancel{2} \times \cancel{2} \times \cancel{2} \times \cancel{2} \times 3 \times 7 \times 11} = \frac{20}{21} \text{ Ans.}$$

In finding the G. C. M. from the factors we have merely to multiply the common factors together. Thus: $2 \times 2 \times 2 \times 2 \times 2 \times 11 = 352$, the G. C. M. of 7040 and 7392. See Treatise, p. 214.

(22) and (23). See (21). (24) to (28). See Ex. 2, p. 70.

(29) to (36). See Ex. 2, p. 71.

XVI. p. 72.

(1) (2). See Ex. 1, p. 72. (3) to (11). See Ex. 2, p. 73.

(12) to (15). See Ex. 3, p. 74.

$$) \quad \frac{2}{13} \times 7\frac{4}{5} = \frac{2}{13} \times \frac{39}{5} = \frac{6}{5} = 1\frac{1}{5}$$

$$\text{then } 1\frac{1}{5} + \frac{2}{5} + \frac{3}{7} + \frac{4}{11} = 1 + \frac{77 + 154 + 165 + 140}{5 \times 7 \times 11} = 1 + \frac{536}{385}$$

$$) \text{ to (24). See Ex. 3, p. 74.} \quad = 2\frac{151}{385} \text{ Ans.}$$

XVII.

No Question under this head differs from the Examples given.

XVIII.

(1) to (3) inclusive are similar to the Examples.

$$(4) \quad 2\frac{3}{4} \times 5\frac{2}{3} = \frac{11}{4} \times \frac{12}{3} = \frac{132}{4} = 16\frac{3}{4} \text{ Ans.}$$

(5) to (18) inclusive. See (4), above.

$$(19) \quad \frac{5 \times \overset{7}{21} \times \overset{1}{12}}{\underset{3}{36}} = 35d. = 2s. 11d.$$

$$(20) \quad \frac{2}{3} \text{ of } £1 = \frac{2 \times 20}{3} = \frac{40s.}{3} = 0 \frac{s.}{13} \frac{d.}{4}$$

$$\frac{3}{7} \text{ of } £7 \overset{7}{10}s. \overset{2}{7}d. = 1 \quad 1 \quad 6$$

$$2\frac{1}{3} \times 16s. = \frac{7 \times 16}{3} = \frac{112}{3} = 1 \quad 17 \quad 4$$

$$\underline{\text{£3} \quad 12 \quad 2}$$

$$(21) \quad \frac{4 \times \overset{4}{20} \times \overset{4}{12}d.}{\underset{5}{15}} = 64d. = 5s. 4d.$$

$$3\frac{3}{13} \times 12d. = 3 \quad 2\frac{10}{13}$$

22) See (4), above.

Ans. 8s. 7d.

XIX.

(1) to (3). See Examples.

$$(4) \text{ £7 } 12s. \text{ } 6d. \times \frac{12}{11} = \frac{\text{£91 } 10s.}{11} = \text{£8 } 6s. \text{ } 4\frac{4}{11}d. \text{ } Ans.$$

(5) to (7). See (4), above.

$$(8) \frac{\frac{3}{4} + \frac{1}{2}}{\frac{3}{4}} = \frac{5}{4} \times \frac{4}{3} = 1\frac{1}{3}; \quad \frac{\frac{3}{4}}{\frac{4}{7}} \div \frac{4}{7} = \frac{3}{4} \times \frac{7}{4} \times \frac{1}{4} = \frac{21}{64}$$

$$\frac{\frac{1}{2} + \frac{1}{4}}{\frac{1}{3} \times \frac{1}{4}} \div \frac{2}{3} = \frac{3}{4} \times \frac{3}{2} \times \frac{12}{1} = \frac{27}{2} = 13\frac{1}{2}$$

(9) See (8), above.

$$(10) \text{ Required fraction} = \frac{7 \times 20}{8 \times 50} = \frac{7}{20}$$

$$(11) \text{ Required fraction} = \frac{3 \times 12}{4 \times 10} = \frac{9}{10}$$

$$(12) \text{ Required fraction} = \frac{4}{7 \times \frac{28}{7} \times 2} = \frac{1}{8}$$

(13) to (26) inclusive. See Examples, pp. 79, 80.

$$(27) \text{ Required fraction} = \frac{2 \times 80}{9 \times 30} = \frac{16}{27}$$

(28) to (30). See Examples 1, 2, p. 71.

(31) and (32). See (20), p. 79.

XX. to XXIII.

All questions under these heads are fully as simple as the samples.

XXIV.

$$\begin{array}{r}
 (1) \quad \begin{array}{r} .25 \overline{) 3.24} \\ \text{or } 25 \overline{) 324} \\ \underline{5} \\ 1 \end{array} \quad \begin{array}{r} 12.96 \text{ Ans.} \end{array}
 \end{array}$$

$$\begin{array}{r}
 .37 \overline{) 7.50} \\ \underline{4} \\ 1 \end{array} \quad \begin{array}{r} 7.8125 \text{ Ans.} \end{array}$$

(3) to (5). See Examples (1) and (2), pp. 88, 89.

$$\begin{array}{r}
 (6) \quad 6,0 \overline{) 47,6532} \text{ tons} \\
 \underline{79422} \\
 20 \\
 \underline{188440} \text{ cwt.} \\
 4 \\
 \underline{3376} \text{ qrs.} \\
 7 \\
 \underline{2632} \\
 4
 \end{array}$$

7 tons 18 cwt. 3 qrs. 10.528 lbs. *Ans.*

$$\begin{array}{r}
 (7) \quad \begin{array}{r} \text{\textsterling} \\ 5.48 \overline{) 880.7643} \\ 1.37 \overline{) 220.191075} \end{array} \quad \begin{array}{r} 160.7234 \\ \underline{137} \\ 831 \\ \underline{822} \\ 991 \\ \underline{959} \\ 320 \\ \underline{274} \\ 467 \\ \underline{411} \\ 565 \\ \underline{548} \end{array}
 \end{array}$$

£160 14s. 5½d.

(8) to (23) inclusive. See Example, p. 88.

$$(24) \frac{.0125}{10000} = \frac{25}{40000} = \frac{5}{8000} = \frac{1}{1600}. \quad (25) \text{ to } (27). \text{ See (24), above.}$$

(28) and (29). See Example, p. 90, at bottom.

(30) See Ex. 1, p. 91.

$$(31) \quad \begin{array}{r} 12 \overline{) 1.5} \\ 2,0 \overline{) 8.125} \\ \hline \pounds 40625 \end{array}$$

$$(32) \quad \frac{6\frac{2}{3}}{20} = \frac{20}{\frac{60}{3}} = .3$$

$$(33) \quad \frac{5 \times \overset{5}{\cancel{600}}}{8 \times 21 \times \cancel{12}} = \frac{25}{8 \times 3 \times 7} = \frac{3 \cdot 125}{3 \times 7} = \frac{1 \cdot 041\bar{6}}{7} = .148\bar{8}0952\bar{3}$$

(34) See (33), above.

(35) See Ex. 1, p. 91.

(36) to (39). See (24), above.

(40) to (43). See Examples 1 and 2, p. 92.

(44) to (55). See Ex. 1, p. 33.

XXV.

(1) to (6). See Examples.

$$(7) \quad .0021 \times 48.026 = \frac{\overset{7}{\cancel{21}}}{\underset{333}{999}} \times 48 \frac{\overset{8}{\cancel{24}}}{\underset{300}{900}} = \frac{7}{333} \times \frac{14408}{300}$$

$$\frac{999000 \ 100856 \ (1.00956 \ Ans.)}{99900}$$

$$\begin{array}{r} 9560 \\ 8991 \\ \hline 5690 \\ 4995 \\ \hline 6950 \\ 5994 \\ \hline 956 \end{array}$$

XXVI. MISCELLANEOUS EXERCISES, page 99.

(1) to (4) See (6) and (7), XXIV.

$$(5) \frac{5}{6} - \frac{2}{5} \times \frac{5}{8} = \frac{5}{6} - \frac{1}{4} = \frac{7}{12} \text{ Ans.}$$

(6) See Ex. 1, p. 82.

(7) See Ex. 1, p. 88.

$$(8) 10 - (1\frac{7}{10} + 3\frac{2}{18} + 2\frac{1}{20} + \frac{5}{24}) =$$

$$10 - \left(6 + \frac{168 + 135 + 12 + 50}{240} \right) = 4 - \frac{365}{240} = 4 - 1\frac{73}{48} = 2\frac{23}{48} \text{ Ans.}$$

$$(9) \frac{3.45 \times 101\frac{1}{2}}{2\frac{1}{2}} = \frac{3.45 \times 21}{\frac{5}{1}} = 14.49$$

(10) See (9).

(11) See Ex. 1, p. 88.

(12) See Ex. 1, p. 79.

(13) See Ex. 2, p. 93.

$$(14) \begin{array}{r} 2 \quad 3042 \quad 3094 \\ \quad 1521 \quad 1547 \\ \quad \quad 507 \quad 221 \\ \quad \quad 169 \quad 17 \\ \hline 13 \quad 13 \end{array}$$

$$\therefore 2 \times 13 = 26 \text{ G.C.M.}$$

$$\therefore \frac{3042}{3094} = \frac{117}{119}. \text{ See p. 214.}$$

(15) to (20). See previous Examples.

$$(21) \frac{1}{7} \times \frac{7}{3} \times \frac{55}{8} \times \frac{5}{22} \times \frac{48}{25} = 1$$

- (22) See (21), p. 79. (23) See p. 90.
 (24) See p. 96. (25) See Ex. 1, p. 88.
 (26) See Ex. 33, p. 91. (27) See Ex. 1, p. 93.
 (28) See Ex. 1, p. 85. (29) See (8), above.
 (30) See (22), above. (31) $15\frac{3}{8} \div \frac{3}{8} = \frac{78}{5} \times \frac{5}{2} = 39$
 (32) See (22), above. (33) See Ex. 1, p. 84.
 (34) See Ex. 2, p. 87. (35) See p. 90.
 (36) See (33), p. 79. (37) See p. 96.
 (38) See Example, p. 90. (39) See Ex. 1, p. 93.
 (40) See Ex. 2, p. 89. (41) See Ex. 1, p. 79.
 (42) See Ex. 2, p. 89. (43) See Ex. 1, p. 92.
 (44) $\frac{3}{9} \times \frac{2}{9} = \frac{2}{9 \times 3} = \frac{.6}{9} = .074$ (45) to (48). See *Answers*.

XXVII. PRACTICE, page 101.

(1) to (5). See Examples.

(6)

$10s. = \frac{1}{2}$ of £1	3107
$4s. = \frac{1}{5}$ „	1553 10
$6d. = \frac{1}{8}$ of 4s.	621 8
$1\frac{1}{2}d. = \frac{1}{4}$ of 6d.	77 13 6
	19 8 4 $\frac{1}{2}$
	£5378 19s. 10 $\frac{1}{2}$ d.

(7) and (8). See (6), above.

$$(9) \quad \begin{array}{r} 4562 \\ 3 \end{array}$$

$$\begin{array}{l} 15s. = \frac{1}{4} \text{ of } £3 \\ 9d. = \frac{1}{8} \text{ of } 15s. \\ \frac{1}{2}d. = \frac{1}{16} \text{ of } 9d. \\ \frac{1}{4} \text{ of } £3 \text{ } 15s. 9\frac{1}{2}d. \end{array} \quad \begin{array}{r} 13686 \\ 3421 \text{ } 10 \\ 171 \text{ } 1 \text{ } 6 \\ 9 \text{ } 10 \text{ } 1 \\ 0 \text{ } 18 \text{ } 11\frac{3}{4} \\ \hline £17289 \text{ } 0s. 6\frac{3}{4}d. \end{array}$$

) to (15). See (6), above. (16) See (9), above.

) to (26). See (6), above. (27) See Ex. 12, p. 108.

) See Ex. 8, p. 105.

$$(29) \quad \begin{array}{r} \text{oz. dwts. grs.} \\ 11 \text{ } 6 \text{ } 15 \\ 1 \text{ } 1 \text{ } \frac{1}{2} \\ \hline 11 \text{ } 6 \text{ } 7\frac{1}{2} \text{ price at } £1 \text{ per oz.} \\ 3 \end{array}$$

$$\begin{array}{l} 15s. = \frac{1}{4} \text{ of } £3 \\ 2s. 6d. = \frac{1}{8} \text{ of } 15s. \\ 3d. = \frac{1}{16} \text{ of } 2s. 6d. \\ 1d. = \frac{1}{3} \text{ of } 3d. \end{array} \quad \begin{array}{r} 33 \text{ } 19 \text{ } 10\frac{1}{2} \text{ } , \text{ } £3 \\ 8 \text{ } 9 \text{ } 11\frac{5}{8} \text{ } , \text{ } 15s. \text{ } , \\ 1 \text{ } 8 \text{ } 3\frac{1}{4} \text{ } , \text{ } 2s. 6d. \text{ } , \\ 0 \text{ } 2 \text{ } 9\frac{1}{8} \text{ } , \text{ } 3d. \text{ } , \\ 0 \text{ } 0 \text{ } 11\frac{3}{8} \text{ } , \text{ } 1d. \text{ } , \\ \hline £44 \text{ } 1s. 11\frac{1}{8}d. \text{ Ans.} \end{array}$$

) to (34). See Ex. 8, p. 105. (34) See Ex. 9, p. 106.

$$(35) \quad \begin{array}{r} \text{tons cwt. lbs.} \\ 8 \text{ } 13 \text{ } 18 \\ 20 \\ \hline 173 \\ 4 \\ \hline 692 \text{ qrs. } 18 \text{ lbs.} \end{array}$$

$$\begin{array}{l} 3d. = \frac{1}{4} \text{ of } 1s. \\ \frac{1}{2}d. = \frac{1}{8} \text{ of } 3d. \\ 14 \text{ lbs.} = \frac{1}{2} \text{ of a qr.} \\ 4 \text{ lbs.} = \frac{1}{7} \text{ } , \end{array} \quad \begin{array}{r} 173 \\ 28 \text{ } 10 \\ 1\frac{3}{4} \\ \hline 2,0) 20,2 \text{ } 0\frac{1}{4} \\ \hline £10 \text{ } 2s. 0\frac{1}{4}d. \text{ Ans.} \end{array}$$

(36) and (37). See Ex. 7, p. 104.

(38)

cwt. qrs. lbs.	
1 1 8	$105 = 7 \times 5 \times 3$
<u>7</u>	
9 1 0	
<u>5</u>	
46 1	
<u>3</u>	
138 3	weight of the 105 pockets
<u>1 5</u>	
138 15	price at £1 per cwt.
<u>4</u>	

10s. = $\frac{1}{2}$ of £1	555 0	,, £4	,,
2s. 6d. = $\frac{1}{4}$ of 10s.	69 7 6	,, 10s.	,,
	17 6 10 $\frac{1}{2}$	,, 2s. 6d.	,,

$\pounds 641 \ 14s. \ 4\frac{1}{2}d.$ Ans.

(39) to (41). See Ex. 10, p. 107.

(42) and (43). See Ex. 12, p. 108.

(44)

2 rds. = $\frac{1}{2}$ of 1 ac.	40 6 8
10 pls. = $\frac{1}{4}$ of 2 rds.	5 0 10
5 pls. = $\frac{1}{2}$ of 10 pls.	2 10 5
4 pls. = $\frac{1}{20}$ of 2 rds.	2 0 4
12 yds. = $\frac{1}{121}$ of 4 pls.	4 0

$\pounds 50 \ 2s. \ 3d.$

(45) and (46). See Examples 13 and 14, p. 110.

(47) See Example 15.

(48)

26 ft. 4 in.
18 8
 45 × 2 = circuit of room

5 7 2
 $\therefore \frac{45 \times 2 \times 12\frac{1}{2}}{9 \times \frac{7}{8}} = \frac{45 \times 2 \times 49 \times 8}{4 \times 4 \times 7} = 140$

(49) See Example 6, p. 103.

$$(50) \quad \frac{16}{11}$$

$27 \times 2 = \text{circuit of room}$

$$\therefore \frac{27 \times 2 \times 10 \times 7\frac{1}{2}d.}{(2\frac{1}{2} \times 3) \times 20 \times 12} = £2 \ 5s.$$

(51) See Ex. 15.

XXVIII. MISCELLANEOUS EXERCISES, page 111.

(1) to (7). See Examples 6 and 7, pp. 101, 102.

$$(9) \quad \begin{array}{r} £25 \ 8 \ 4 \\ 9 \end{array}$$

4 fur. = $\frac{1}{2}$ of 1 mile
1 „ = $\frac{1}{4}$ of 4 fur.
8 pls. or 44 yds. = $\frac{1}{8}$ of 1 „

228	15	0	cost of 9 miles
12	14	2	„ 4 furlongs
3	3	6 $\frac{1}{2}$	„ 1 furlong
0	12	8 $\frac{1}{2}$	„ 44 yards
£245 5s. 5d.			

(10) See (29), p. 105.

(11) See (38), p. 107.

(12) to (18). Same as Examples.

$$(19) \quad \frac{17}{20} \text{ of } \frac{1}{4} = \frac{3}{20}$$

$$\begin{array}{r} 85960 \\ 1d. = \frac{1}{12} \text{ of } 1s. \quad \begin{array}{r} 7163 \ 4 \\ 716 \ 4 \\ 358 \ 2 \end{array} \\ \frac{2}{20} = \frac{1}{10} \text{ of } 1d. \\ \frac{1}{20} = \frac{1}{2} \text{ of } \frac{2}{20} \\ 2,0) 823,7 \ 10 \\ \underline{\hspace{1cm}} \\ £411 \ 17s. \ 10d. \end{array}$$

(20) and (21). See (9), p. 104. (22) to (24). See Ex. 10, p. 10

(25) See Ex. 7, p. 104.

(26) See (29), p. 105.

(27) See (50), p. 111.

(28) See Ex. 11, p. 108.

$$\begin{array}{r} (29) \quad \text{£}1 \quad 0 \quad 0 \\ \quad \quad 14 \quad 9\frac{1}{2} \\ \hline \quad \quad 5s. \quad 2\frac{1}{2}d. \end{array}$$

$$\begin{array}{r} \text{£}1384 \quad 16 \\ 5s. = \frac{1}{4} \text{ of } \text{£}1 \quad \boxed{\begin{array}{r} 346 \quad 4 \\ 14 \quad 8 \quad 6 \end{array}} \\ 2\frac{1}{2}d. = \frac{1}{24} \text{ of } 5s. \\ \hline \text{£}360 \quad 12s. \quad 6d. \end{array}$$

(30) See note to *Answer*.

(31) See Ex. 7, p. 104.

$$\begin{array}{r} (32) \quad \text{£}3 \quad 18 \quad 8 \\ \quad \quad \quad 6 \\ \hline \begin{array}{l} 2 \text{ bus.} = \frac{1}{4} \text{ of } 1 \text{ qr.} \\ 1 \text{ ,,} = \frac{1}{2} \text{ of } 2 \text{ bus.} \\ 1 \text{ pk.} = \frac{1}{4} \text{ of } 1 \text{ ,,} \\ \frac{1}{2} \text{ ,,} = \frac{1}{2} \text{ of } 1 \text{ pk.} \\ \frac{1}{4} \text{ ,,} = \frac{1}{2} \text{ of } \frac{1}{2} \text{ ,,} \end{array} \quad \boxed{\begin{array}{r} 23 \quad 12 \quad 0 \\ 19 \quad 8 \\ 9 \quad 10 \\ 2 \quad 5\frac{1}{2} \\ 1 \quad 2\frac{1}{4} \\ 7\frac{3}{8} \end{array}} \\ \hline \text{£}25 \quad 5s. \quad 9\frac{1}{2}d. \end{array}$$

(33) to (40). Same as Examples. (41) See (9), above.

(42) to (49). Same as Examples.

$$\begin{array}{r} (50) \quad \begin{array}{r} \text{yds.} \quad \text{qrs.} \quad \text{nls.} \\ 329 \quad 3 \quad 2 \\ 4 \\ \hline 1319 \text{ qrs.} \quad 2 \text{ nls.} \\ 1 \quad 5 \\ \hline 1319 \quad 10 \text{ cost at } \text{£}1 \text{ per qr.} \end{array} \\ 5s. = \frac{1}{4} \text{ of } \text{£}1 \quad \boxed{\begin{array}{r} 329 \quad 17 \quad 6 \\ 13 \quad 14 \quad 10\frac{3}{4} \end{array}} \quad \text{,,} \quad 5s. \quad \text{,,} \\ 2\frac{1}{2}d. = \frac{1}{24} \text{ of } 5s. \\ \hline \text{£}343 \quad 12s. \quad 4\frac{3}{4}d. \text{ Ans.} \end{array}$$

(51) and (52). See (6), above.

(53) See Ex. 9, p. 106.

XXIX. SIMPLE PROPORTION, page 118.

Questions (1) to (42) inclusive are as simple as the Examples worked.

$$(43) \quad 5 \text{ cwt. } 2 \text{ qrs. } 20 \text{ lbs.} = 636 \text{ lbs.}$$

$$\text{ratio of } 2s. \ 6d. \text{ to } 2s. = 30 : 24 = 5 : 4$$

$$\therefore \text{First man's share} = \frac{53}{\cancel{3} \times \cancel{12} \times \cancel{20}} \times \frac{2\frac{1}{2} \times 1}{\cancel{4}} = \frac{53 \times 5}{3 \times 4 \times 2} = \frac{265}{3 \times 8}$$

$$= \frac{\pounds 88 \ 6s. \ 8d.}{8} = \pounds 11 \ 0s. \ 10d. \quad \text{Share of second} = \frac{53}{\cancel{3} \times \cancel{12} \times \cancel{20}} \times \frac{2\frac{1}{2} \times 2\frac{1}{2} \times 4}{\cancel{3} \times \cancel{3} \times \cancel{5}} = \frac{265}{8}$$

$$= \pounds 33 \ 16s. \ 8d. \text{ Ans.}$$

$$(44) \quad \text{Work done in } 10 \times 10\frac{1}{2} \times 9 = 945 \text{ hours}$$

$$\text{the three men work } 3 \times 6 \times 10 = 180 \text{ hours}$$

$$\therefore \text{the others must work } \frac{945 - 180}{7 \times 10} = \frac{765}{70} = 10\frac{3}{4} \text{ hrs. a day}$$

XXX. COMPOUND PROPORTION, page 126.

(1) See Examples.

$$(2) \quad \begin{array}{l} 7 \text{ men} : 30 \text{ men} :: 34 \text{ ac.} : \text{no. of acres required} \\ 12 \text{ days} : 11 \text{ days} :: \\ 8\frac{1}{2} \text{ hrs.} : 7\frac{1}{2} \text{ hrs.} \end{array}$$

$$\therefore \text{no. of acres} = \frac{\cancel{7} \times \cancel{12} \times 34 \times \cancel{39} \times \cancel{4}}{\cancel{30} \times \cancel{11} \times \cancel{33} \times \cancel{5}} = \frac{284}{1} = 284$$

(8) to (10). Same as Examples.

(11) Time by coach = $13\frac{2}{3} = 15\frac{1}{3}$ hrs.

$$\therefore \text{ „ „ train} = 23 : 11 :: 15\frac{1}{3} = \frac{11 \times 46}{23 \times 3} = 7\frac{1}{3} \text{ hrs.}$$

$$\therefore 15\frac{1}{3} - 7\frac{1}{3} = 8 \text{ hours' time gained by taking the train.}$$

(12) See (2), above.

XXXI. MISCELLANEOUS EXERCISES, page 127.

(1) to (10). See Examples 1, 2, 3, Simple Proportion.

(10) From 1st May to 31st October = 184 days, and $365 - 184 = 181$

$$\therefore \text{Required cost} = (184 + 1\frac{1}{2}) \times 800 \times 1\frac{1}{2} \times 6\frac{2}{3}d.$$

$$= 274\frac{1}{2} \times \frac{800}{1} \times \frac{3}{2} \times \frac{4}{3} = \frac{549 \times 800 \times 6 \times 59}{2 \times 240 \times 3} = £7198$$

$$(11) \text{ Required sum} = \frac{7 \times 8 \times 9 \times 10 \times 11 \times 12}{20 \times 12} = \frac{854}{2} \times 7 = £299 \text{ 5s.}$$

(12) See (19), p. 112.

(13) See Ex. 3, p. 120.

(14) to (17). See Examples.

(18) $20 : 21 :: 44\frac{1}{2} : \text{required number}$

$$\therefore \frac{21 \times 89}{20 \times 2} = 46\frac{2}{5} \text{ Ans.}$$

(19) See Example 7, p. 104.

1) $£4726\frac{1}{2} : £1 :: 1181\frac{5}{8} : \text{required sum}$

$$\therefore \frac{9453 \times 2}{8 \times 9453} = \frac{1}{4} \text{ or } 5s. \text{ Ans.}$$

1) See p. 125, Ex. 1.

1) $22 \times 19 : 27 \times 16 :: £18 \ 5s. \ 9d. : \text{required sum}$

$$\therefore \frac{27 \times 16 \times 21}{22 \times 19 \times 20 \times 12} = \frac{189}{10} = £18 \ 18s. \text{ Ans.}$$

3) See (50), p. 111.

1) $\frac{5s. \ 6d. + 4s. \ 6d.}{2} = 5s. \text{ average cost}$

$$\text{Required cost} = \frac{3500 \times 5}{100 \times 20} = £8 \ 15s.$$

i) $£1 : £125 \ 10s. :: 23 \text{ fr. } 6 \text{ cen.} : \text{Answer}$

$$\therefore \text{Ans.} = 125.5 \times 23.06 = 2894 \text{ fr. } 30 \text{ centimes}$$

5) to (35) are similar to the Examples in Treatise.

1) $\left. \begin{array}{l} 221 : 437 \\ 57 : 119 \\ 1 : 2 \end{array} \right\} :: 780 \text{ men} : \text{required number}$

$$\therefore \text{Ans.} = \frac{437 \times 119 \times 20}{221 \times 57} = 6440$$

1) $93\frac{1}{2} : 89\frac{1}{4} :: 76\frac{1}{2} : \text{required price}$

$$\therefore \text{Required price} = \frac{357 \times 153 \times 2}{4 \times 2 \times 187} = 24\frac{1}{4} = 73\frac{1}{4}$$

$$\begin{array}{r}
 \text{(38) Number of yards} = 27\frac{1}{3} \times 10\frac{7}{8} \\
 \begin{array}{r}
 3 \\
 75 \\
 900 \\
 36 \\
 \hline
 7\frac{1}{3} \times 3
 \end{array}
 = \frac{41}{3} \times \frac{33}{3} \times \frac{3}{3} = \frac{451}{3} \\
 = 12\frac{52}{3}
 \end{array}$$

(39) See note, p. 130.

(40) The ratios of 80, 100, 60, and 20 are the same as 4, 5, 3, and 1

$$\begin{array}{r}
 \therefore 4 \times 14d. = 56d. \\
 5 \times 20 = 100 \\
 3 \times 58 = 174 \\
 1 \times 34 = 34 \\
 \hline
 13 \text{ lbs.} = 364
 \end{array}$$

$$\begin{array}{r}
 7 \\
 28 \\
 364 \times 3 \\
 \hline
 13 \times 10 \\
 1 \quad 4 \\
 \therefore \text{Required value} = \frac{364 \times 3}{13 \times 10} = \frac{21}{5} = 5\frac{1}{5}d.
 \end{array}$$

(41) See Ex. 2, p. 119.

$$(42) \text{ Ans.} = \frac{\text{£}257 \text{ 2s.}}{85\frac{1}{4}} = \text{£}3$$

(43) See Ex. 1, p. 125.

(44) See Ex. 5, p. 122.

(45) and (46). See Examples. (47) See (20), above.

(48) See Ex. 3, p. 120.

(49) See (37), above.

(50) 3 bus. : 12 qrs. 2 bus. 1 pk. :: 16s. 9d. : Answer

$$\begin{array}{r}
 4 \quad 8 \quad 12 \\
 12 \quad 98 \quad 201 \\
 4 \\
 \hline
 393
 \end{array}$$

$$\begin{array}{r}
 131 \quad 67 \\
 393 \times 201 \\
 \hline
 12 \times 20 \times 12 \\
 4 \quad 4 \\
 = \frac{8777}{320} = \text{£}27 \text{ 8s. } 6\frac{3}{4}d.
 \end{array}$$

(51) See (16), above.

(52) See (42), above.

b) See Ex. 4, p. 121.

(54) See Ex. 5, p. 122.

c) See Ex. 2, p. 119.

d) £1078 : £78 10s. :: £370 18s. 5½d.

$$\begin{array}{r}
 \begin{array}{r}
 20 \\
 \hline
 21560
 \end{array}
 \quad
 \begin{array}{r}
 20 \\
 \hline
 1570
 \end{array}
 \quad
 \begin{array}{r}
 12 \\
 \hline
 4451 \quad 1 \quad 6 \\
 12 \\
 \hline
 53412 \quad 18 \quad 0 \\
 4451 \quad 1 \quad 6 \\
 370 \quad 18 \quad 5\frac{1}{2} \\
 \hline
 2156) 58234 \quad 17 \quad 11\frac{1}{2} \quad (\text{£27 0s. 2d.} \\
 \underline{4312} \\
 15114 \\
 \underline{15092} \\
 22 \\
 20 \\
 \hline
 457 \\
 12 \\
 \hline
 5495 \\
 4312 \\
 \hline
 1183 \\
 2 \\
 \hline
 2367 \\
 2156 \times 2 = 4312
 \end{array}$$

e) and (58). See Ex. 3, p. 120.

f) 90 pioneers : 48 pioneers
42 days : 5 days :: 12½ hours

$$189\frac{3}{4} \times 4\frac{1}{2} \times 2\frac{1}{2} : 4910\frac{1}{16} \times 4\frac{7}{8} \times 3\frac{1}{2}$$

$$\begin{array}{r}
 \begin{array}{r}
 4 \\
 8 \quad 1 \\
 \hline
 1247 \\
 8729 \\
 \hline
 100 \times 42 \times 559 \times 16 \times 8 \times 5 \times 2 \times 9 \times 5 \\
 \hline
 15 \quad 6 \quad 43 \quad 4 \quad 1 \\
 3 \quad 2 \quad 2
 \end{array}
 \end{array}$$

XXXII. THE CHAIN RULE, page 132.

- (1) *Ans.* = 21 claret
 14 claret = 18 sherry
 12 sherry = 8 brandy
 6 brandy = 10 malt

$$= \frac{\overset{3}{21} \times \overset{3}{18} \times \overset{2}{8} \times 10}{\underset{2}{14} \times \underset{2}{12} \times \underset{2}{6}} = 30 \text{ galls.}$$

- (2) and (3). See (1).

XXXIII. PARTNERSHIP, page 133.

- (1) to (3). See Examples under the Rule.

XXXIV. SIMPLE INTEREST, page 134.

$$(1) \text{ Interest} = \frac{\pounds 507\frac{1}{2} \times 13 \times \overset{203}{4}}{100 \times 4} = \frac{\overset{1015}{1015} \times 13}{\underset{20}{1000} \times 2} = \frac{2432}{40} = \pounds 65 \text{ 19s. 6d.}$$

$$(2) \text{ Interest} = \frac{\pounds 1257\frac{3}{4} \times 23 \times \overset{50 \cdot 31}{4}}{100 \times 4} = \frac{\overset{5031}{5031} \times 23}{4 \times 100} = \frac{1157 \cdot 13}{4} = \pounds 289 \text{ 5s. 7}\frac{1}{2}\text{d.}$$

$$(3) \text{ Interest} = \frac{\overset{10}{\pounds 3000} \times \overset{1}{4} \times 8}{\underset{3}{1200}} = \pounds 80; \text{ then income-tax on } \pounds 80 \text{ for}$$

$$8 \text{ months} = \frac{\overset{4}{80} \times \overset{2}{8} \times 14d.}{\underset{3}{12} \times \underset{3}{12} \times \underset{3}{20}} = \frac{22}{3} = \pounds 3 \text{ 2s. 2}\frac{2}{3}\text{d.}$$

$$\therefore \pounds 80 - \pounds 3 \text{ 2s. 2}\frac{2}{3}\text{d.} = \pounds 76 \text{ 17s. 9}\frac{1}{3}\text{d. } \textit{Ans.}$$

(4) to (7). See (1) and (2), above.

(8) March	28
April	30
May	31
June	30
July	31
August	31
September	30
October	31
November	30
December	18
	<u>290</u>

$$\text{Now interest} = \frac{\pounds 194 \times 5 \times 290}{\cancel{36500} \atop 730} = \frac{5626}{730} = \pounds 7 \text{ } 14\text{s. } 1\frac{1}{3}\text{d.}$$

(9) and (10). See (1) and (2), above. (11) See (8), above.

(12) $\frac{\pounds 76 \text{ } 5\text{s. } 1\frac{1}{2}\text{d.}}{2} = \pounds 38 \text{ } 2\text{s. } 6\frac{3}{4}\text{d.}$ interest on $\pounds 1270 \text{ } 18\text{s. } 9\text{d.}$ for one year

$\therefore \text{Rate per cent.} = \pounds 1270 \text{ } 18\text{s. } 9\text{d.} : \pounds 100 :: \pounds 38 \text{ } 2\text{s. } 6\frac{3}{4}\text{d.}$

$$\begin{array}{r} \begin{array}{ccc} \pounds & \text{s.} & \text{d.} \\ 38 & 2 & 6\frac{3}{4} \\ & & 10 \\ \hline 381 & 5 & 7\frac{1}{8} \\ & & 10 \\ \hline \pounds 1270 \text{ } 18\text{s. } 9\text{d.} & 3812 & 16 \text{ } 3 \end{array} \end{array} \quad \begin{array}{l} (3 \text{ Ans.}) \\ 3812 \text{ } 16 \text{ } 3 \end{array}$$

(13) to (15). See (12), above.

(16) Interest on $\pounds 171 \text{ } 7\text{s. } 6\text{d.} = \pounds 217 \text{ } 1\text{s. } 6\text{d.} - \pounds 171 \text{ } 7\text{s. } 6\text{d.} = \pounds 45 \text{ } 14\text{s.}$

$$\text{Required time} = \frac{\pounds 45 \text{ } 14\text{s.}}{\pounds 171 \text{ } 7\text{s. } 6\text{d.} \times 3\frac{1}{3}} = \frac{\pounds 45 \text{ } 14\text{s.} \times 100 \times 3}{\pounds 171 \text{ } 7\text{s. } 6\text{d.} \times 10} = \frac{\pounds 135 \text{ } 42\text{s.}}{\pounds 171 \text{ } 7\text{s. } 6\text{d.}} = 8 \text{ yrs.}$$

(17) See (16), above.

$$(18) \quad 106\frac{1}{2} : £45 \text{ 0s. } 9\frac{3}{4}d. :: 100 : \text{required sum}$$

$$\therefore \text{Required sum} = \frac{£45 \text{ 0s. } 9\frac{3}{4}d. \times 100 \times 2}{213} = £42 \text{ 5s. } 10d.$$

(19) See (18), above.

(20) and (21). See (1), above.

(22) See (18), above.

(23) See (8), above.

(24) See (12), above.

(25) See (18), above.

(26) See (12), above.

(27) See (1), above.

(28) See (16), above.

(29) See (1), above.

(30) See (12), above.

XXXV. DISCOUNT, page 144.

$$(1) \text{ Interest of } £100 \text{ from 15th March till 28th July at 5 per cent.} = \frac{100 \times 5 \times 135}{36500} = \frac{135}{73}$$

$$\text{Now } £100\frac{135}{73} : £743\frac{1}{2} :: \frac{135}{73} : \text{discount required}$$

$$\therefore \text{Discount required} = \frac{73 \times 1487 \times 135}{7435 \times 73 \times 2} = £13 \text{ 10s.}$$

$$\text{And } £743 \text{ 10s.} - £13 \text{ 10s.} = £730 \text{ the present worth.}$$

(2) See (1), above.

$$(3) \quad 108 : 18s. :: 100 : \text{required price}$$

$$\therefore \text{Required price} = \frac{100 \times 18}{108} = 16s. \text{ 8d.}$$

(4) to (10). See (1), above.

(11) Since discount on £105 at 5 per cent. = £5

5 : 15 :: £105 : required sum

$$\therefore \text{Required sum} = \frac{105 \times 15}{5} = £315$$

XXXVI. COMMISSION, page 146.

(1) to (6). See Examples in Treatise.

(7) £234,0

$£2\frac{1}{2} = \frac{1}{40}$ of £100	58. 10	premium at £2 10s. p.c.
$6d. = \frac{1}{160}$ of £2½	0 11 8½	,, ,, 6d. ,,
	£57 18s. 3½d.	Ans.

(8) See note, p. 146.

(9) 95 : 1805 :: 100 : required sum

$$\therefore \text{Required sum} = \frac{1805 \times 100}{95} = £1900$$

(10) and (11). See (7), above.

XXXVII. EQUATION OF PAYMENTS, page 147.

(1) See Ex. 1.

(4) $\frac{1}{2} \times 2 = 1$
 $\frac{1}{3} \times 4 = 1\frac{1}{3}$
 $\frac{1}{6} \times 12 = 2$

(2) (3) and (5). See Ex. 2.

$\frac{1}{4} \times 4 = 1$
4½ Ans.

XXXVIII. THE STOCKS, page 150.

$$(1) \text{ Amount of stock} = \frac{\overset{358}{\cancel{£6802}} \times \overset{25}{\cancel{100}}}{\underset{19}{76}} = £8950$$

(2) and (3). See (1), above.

$$(4) \text{ Number of shares} = \frac{£503\frac{1}{2}}{26\frac{1}{2}} = \frac{1007}{53} = 19$$

$$(5) \text{ Number of shares} = \frac{£4600}{28\frac{5}{8} + \frac{1}{8}} = 160$$

$$(6) \text{ Amount required} = \frac{1850 \times 87\frac{1}{8}}{100} = £1611 \text{ } 16s. \text{ } 3d.$$

(7) and (8). See (6), above.

$$(9) \text{ Amount required} = \frac{£4770 \times 35\frac{3}{8}}{100} = £16873 \text{ } 17s. \text{ } 6d.$$

$$(10) \text{ Amount required} = \frac{£6850 \times 76\frac{1}{4}}{100} = £5223 \text{ } 2s. \text{ } 6d.$$

$$(11) \text{ Income required} = \frac{£2560 \text{ } 8s. \text{ } 9d. \times 3}{72\frac{1}{8}} = £106 \text{ } 10s.$$

(12) to (14). See (11), above.

$$(15) \text{ Income required} = \frac{£1128 \text{ } 8s. \text{ } 9d. \times 2\frac{1}{2}}{28\frac{5}{8} + \frac{1}{8}} = £98 \text{ } 2s. \text{ } 6d.$$

(16) to (18). See Ex. 5.

$$(19) \text{ Required rate} = \frac{10 \times 12}{30} = 4$$

(20) See Ex. 1, p. 150.

$$(21) \text{ First income} = \frac{29 \cdot 54}{100} \times 3 = £88 \cdot 62$$

$$\text{Then } \left. \begin{array}{l} 3 : 4 \\ 98 : 80\frac{1}{2} \end{array} \right\} :: £88 \cdot 62 : \text{second income}$$

$$\therefore \text{ Second income} = \frac{4 \cdot 22}{\cancel{4} \times \cancel{98} \times \cancel{2}} \times \frac{\cancel{29} \cdot \cancel{54}}{\cancel{98} \times \cancel{2}} \times \frac{23}{\cancel{49}} = 97 \cdot 06$$

$$\therefore \text{ Increase} = £97 \cdot 06 - £88 \cdot 62 = 8 \cdot 44 = £8 \text{ 8s. } 9\frac{3}{4}d.$$

(22) See Ex. 1, p. 150.

$$(23) \text{ Average selling price} = (94\frac{7}{8} + 95\frac{5}{8}) \div 2 = 95\frac{1}{4}$$

$$\therefore \text{ Loss} = (96 - 95\frac{1}{4}) \times 100 = £75 \text{ Ans.}$$

$$(24) \left. \begin{array}{l} 3 : 5 \\ 100 : 96 \end{array} \right\} :: 100 \text{ or first income} : \text{second income}$$

$$\therefore \text{ Second income} = \frac{32}{100 \times \cancel{3}} \times \frac{5 \times \cancel{96} \times 100}{\cancel{100} \times \cancel{3}} = £160$$

$$\therefore \text{ Increase per cent.} = 160 - 100 = 60$$

$$(25) \text{ First income} = \frac{£7500 \times 6}{100} = £450$$

$$\therefore \left. \begin{array}{l} 96 : 120 \\ 6 : 3 \end{array} \right\} :: 225 : \text{income from one half}$$

$$= \frac{\cancel{120} \times \cancel{3} \times 225}{\cancel{96} \times \cancel{6}} = £140 \text{ 12s. } 6d.$$

$$\text{Again :—} \left. \begin{array}{l} 90 : 120 \\ 6 : 5\frac{1}{2} \end{array} \right\} :: £225 : \text{income from second half}$$

$$= \frac{120 \times 11 \times 225}{90 \times 2 \times 6} = £275$$

$$\therefore £450 - £415 \text{ 12s. } 6d. = £34 \text{ 7s. } 6d. \text{ decrease.}$$

(26) See (21), above.

$$(27) \text{ First income} = \frac{\pounds 9075 \times 3}{90\frac{3}{4}} = 300$$

$$\left. \begin{array}{l} 3 : 3\frac{1}{4} \\ 93\frac{1}{2} : 91 \end{array} \right\} :: 300 : \text{second income}$$

$$\therefore \text{Second income} = \frac{13 \times 300 \times 91 \times 2}{4 \times 187 \times 3} = \pounds 316 \text{ 6s. } 2\frac{8}{187}d.$$

$$\therefore \text{Increase} = \pounds 316 \text{ 6s. } 2\frac{8}{187}d. - \pounds 300 = \pounds 16 \text{ 6s. } 2\frac{8}{187}d.$$

$$(28) \quad \left. \begin{array}{l} \pounds 3\frac{1}{2} : \pounds 932 \\ 233d. : 240d. \end{array} \right\} :: \pounds 91 : \text{sum required}$$

$$\therefore \text{Sum required} = \frac{4 \quad 13}{7 \times 233} \times 91 \times 240 \times 2 = \pounds 24960$$

(29) See (27), above.

$$(30) \text{ First income} = \frac{6000 \times 3}{100} = \pounds 180$$

$$\left. \begin{array}{l} 3 : 5\frac{1}{2} \\ 103\frac{1}{8} : 92\frac{1}{4} \end{array} \right\} :: 180 : \text{second income}$$

$$\therefore \text{Second income} = \frac{12 \quad 36 \quad 123 \quad 2}{2 \times 4 \times 3 \times 825} \times 11 \times 180 \times 369 \times 8 = \pounds 295 \text{ 4s.}$$

$$\therefore \text{Increase} = \pounds 295 \text{ 4s.} - \pounds 180 = \pounds 115 \text{ 4s.}$$

(31) See (30), above.

$$(32) \quad \begin{array}{l} \pounds 1 \text{ in } 3 \text{ per Cents. gives } \frac{3}{89\frac{3}{8}} \\ \pounds 1 \text{ in railway shares gives } \frac{5}{102\frac{5}{8}} \end{array}$$

$$\therefore \text{Answer} = \frac{3}{89\frac{3}{8}} : \frac{5}{102\frac{5}{8}}$$

$$= \frac{3}{715} : \frac{5}{821} = 24 \times 821 : 40 \times 715 = 2463 : 3575$$

XXXIX. PROFIT AND LOSS, page 156.

(1) $100 : 74s. :: 116 : \text{required price}$

$$\therefore \text{Required price} = \frac{116 \times 74s.}{100} = £4 \ 5s. \ 10\frac{2}{5}d.$$

(2) $115 : \frac{£75}{200} \text{ selling price per yard} :: 100 : \text{prime cost}$

$$\therefore \text{Prime cost} = \frac{£75 \times 100}{115 \times 200} = 6s. \ 6\frac{2}{3}d.$$

(3) $£3 \ 6s. \ 8d. \text{ per cwt.} = \frac{89}{112}d. \text{ per lb.}$

$$\therefore \frac{89}{112} : 110 :: 7\frac{1}{2} : \text{Answer} + 100$$

$$\therefore \text{Answer} = \frac{110 \times \frac{3}{4} \times \frac{7}{112}}{\frac{89}{16} \times 2} - 100 = 2\frac{1}{2} - 100 = 15\frac{1}{2}$$

(4) See (1), above.

(5) Loss if sold for $£80 = 100 + 12 - 80 = £32$

$$\therefore \text{Entire loss} = \frac{60 \times 32}{80} = £24$$

$$\text{First cost} = \frac{60 \times 100}{80} = £75$$

(6) $90 : 15s. :: 118 : \text{required price}$

$$\therefore \text{Required price} = \frac{118 \times 15}{90} = 19s. \ 8d.$$

(7) See Ex. 8, p. 105.

(8) See (2), above.

(9) $100 : 7\frac{1}{2}d. :: 6\frac{2}{3} : \text{gain on each lb.}$

$$\therefore \text{Gain on each lb.} = \frac{20 \times 15}{3 \times 2 \times 100} = \frac{1}{2}d.$$

$$\therefore \text{Number of lbs.} = \frac{£63 \ 12s. \ 3d. \times 112}{\frac{1}{2}} = 274 \text{ cwt. } 2 \text{ qrs. } 14 \text{ lbs.}$$

$$(10) \text{ Gain on each stone} = \frac{\text{£}14 \text{ } 11s. \text{ } 8d.}{500} = \frac{3500d.}{500} = 7d. = 12\frac{1}{2} \text{ p.c.} = \frac{1}{8}$$

∴ First cost = $7d. \times 8 = 4s. \text{ } 8d.$, and selling price = $4s. \text{ } 8d. + 4s. \text{ } 8d. + 8 = 5s. \text{ } 3d.$

(11) See Ex. 2, p. 155.

(12) See (3), above.

$$(13) \text{ 3 cwt. at } 5d. \text{ per lb.} + 7 \text{ cwt. at } 6\frac{1}{2}d. \text{ per lb.} = 336 \times 5d. + 784 \times 6\frac{1}{2}d. = 6776d. \text{ prime cost of 10 cwt.}$$

$$5\frac{1}{2} \text{ cwt. at } 5\frac{1}{2}d. \text{ per lb.} = 3388d.$$

$$\text{Therefore required price per lb.} = (6776d. - 3388d. + 6776d.$$

$$\times \frac{50}{100}) \div 4\frac{1}{2} \times 112 = 6776 \div 504 = 847 \div 63 = 121 \div 9 = 13\frac{2}{3}d.$$

(14) See Ex. 2, p. 155.

XL. AVERAGES AND PERCENTAGES, page 160.

(1) See (3), p. 156, above. (2) See Ex. 1, above.

$$(3) \text{ Required population} = 1256 \cdot 5 \times 6 - (1236 + 452 + 364 + 516 + 3430) = 7539 - 5998 = 1541.$$

$$(4) \text{ Loss on } \text{£}100 = \text{£}100 - \text{£}91\frac{2}{3} = \text{£}8\frac{1}{3}$$

$$\therefore \text{£}100 : \frac{\text{£}3484}{5} :: \text{£}8\frac{1}{3} : \text{required loss}$$

$$\therefore \text{Required loss} = \frac{3484 \times 75}{5 \times 100 \times 3} = \text{£}58 \text{ } 1s. \text{ } 4d.$$

(5) See Ex. 4, p. 159.

$$(6) \text{ Required gain} = \frac{100 \times 14}{22} = 63\frac{7}{11}$$

(7) See Ex. 1, p. 157.

(8) See Ex. 2, p. 165.

(9) See (1), p. 156.

(10) See Ex. 2, p. 145.

(11) See (13), p. 157.

$$(12) \text{ Required number} = \frac{84624 \times 100 \times 100}{86 \times 82} = 120000$$

$$(13) \text{ Population of both countries in 1841} = 28,786,000$$

$$\text{ " " " 1851} = \frac{21476000 \times 108.45}{100}$$

$$+ \frac{7310000 \times 87.5}{100} = 29686972$$

$$\therefore 28,786,000 : 29686972 :: 100 : 100 + \text{required increase}$$

$$\therefore \text{ Required increase} = \frac{29,686,972 \times 100}{28,786,000} - 100 = 3.129896\ldots$$

(14) See Examples 1 and 2, p. 145.

$$(15) \text{ Average in 1st class} = \frac{6186899}{4355.5} = 1420.479\ldots$$

$$\text{ " " 2nd " } = \frac{18844152}{4355.5} = 4326.518\ldots$$

$$\text{ " " 3rd " } = \frac{24848312}{3455.5} = 5705.042\ldots$$

$$(16) \text{ Percentage of first class} = \frac{6186899 \times 100}{6186899 + 18844152 + 24848312} = 12.4\ldots$$

The percentages of second and third are found in the same manner.

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XLI. INVOLUTION, page 162.

The Questions under this head are as simple as the Examples.

XLII. SQUARE ROOT, page 165.

(1) and (2). See Ex. 2, p. 164.

(3) $\sqrt{262\frac{1}{2}} = \sqrt{\frac{524\frac{1}{2}}{2}} = \frac{23}{2} = 11\frac{1}{2}$. In general it is better to reduce a mixed number to an improper fraction before extracting the root.

(4) to (6). See (3), above. (7) to (9). See Ex. 2.

XLIII. CUBE ROOT, page 166.

- (1) to (3). See Example in Treatise.
- (4) $\sqrt[3]{5164308} = \sqrt[3]{1771561} = 121 = 17\frac{1}{2}$ Ans.
- (5) to (10). See Examples, and KEY, page 40.

XLIV. PROGRESSIONS, page 167.

Questions in Progressions are now very seldom given; and, those under this head being as easy as the Examples, none are worked here.

XLV. COMPOUND INTEREST, page 171.

- (1) to (4). See Ex. 1, p. 170.
- (5) Required sum $= \frac{\pounds 512 \cdot 578125}{1 \cdot 0125^3} = \frac{\pounds 512 \cdot 578125}{1 \cdot 02515625} = \pounds 500$
- (6) Required amount $= \pounds 4800 \times 1 \cdot 03125^3$
 $= 4800 \times 1 \cdot 096710205078125 = \pounds 5264 \text{ 4s. } 2\frac{5}{8}d.$
- (7) to (12). See (6), above.

XLVI. LOGARITHMS, page 175.

The Questions under this head are as easy as the Examples.

XLVII. EXAMINATION PAPERS, page 176.

This and the two following Papers are in the Elementary Rules.

LI. EXAMINATION PAPERS, page 178.

(1) to (18) are very elementary, and the same as many worked in the beginning of the Treatise.

	tuns	hhds.	galls.	qts.	pt.
(19)	467	3	26	2	1
	4				
	1871	hhds.			
	7				
	13097				
	9				
	117899	galls.			
	4				
	471598	quarts			
	2				
	943197	pints			

(20) See Ex. 3, p. 32. (21) See (19), above.

LII. EXAMINATION PAPERS, page 179.

(1) to (15) are similar to numerous Examples worked in the Treatise.

(16) $8\frac{1}{2} \times 112$ lbs. : $195\frac{1}{2}$ lbs. :: 42 guineas $\times \frac{21}{20}$: required cost

$$\therefore \text{Required cost} = \frac{71 \times 21 \times 3}{4 \times 20 \times 33 \times 112} = \frac{149,1}{16,0} = \text{£}9 \text{ 6s. } 4\frac{1}{2}d.$$

(17) to (24). See similar Questions, KEY, pages 43 and 44.

(25)

0000 75)	480-000000
175)	90000000
35	19200000
7	3840000
1	548571-428571 Ans.

$$(26) \quad \frac{9s. 4\frac{1}{2}d.}{20s.} = \frac{112.5}{240} = \frac{11.25}{24} = \frac{1.40625}{3} = .46875 \text{ s.}$$

$$(27) \quad \begin{array}{r} 300 \times 4 = 1200 \\ 30 \times 2 \times 9 = 540 \\ 92 = 81 \\ \hline 1821 \\ 81 \\ \hline 252300 \\ 30 \times 29 \times 2 = 1740 \\ 2^2 = 4 \\ \hline 254044 \\ 4 \\ \hline 25579200 \\ 30 \times 292 \times 4 = 35040 \\ 4^2 = 16 \\ \hline 25614256 \\ 16 \\ \hline 2564932800 \end{array} \quad \begin{array}{r} 25.000,000,000,000 \\ 8 \\ \hline 17000 (2.9240 \\ 16389 \\ \hline 611000 \\ 508088 \\ \hline 102912000 \\ 102457024 \\ \hline 454976000 \end{array}$$

$$(28) \quad \begin{array}{r} 3 \text{ ft. } 1' \quad 11'' \\ 4 \quad 6 \quad 8 \\ \hline 12 \quad 7 \quad 8 \\ 1 \quad 6 \quad 11 \quad 6''' \\ \quad 2 \quad 1 \quad 3 \quad 4''' \\ \hline 14 \quad 4 \quad 8 \quad 9 \quad 4 \\ 2 \quad 7 \\ \hline 28 \quad 9 \quad 5 \quad 6 \quad 8 \\ 8 \quad 4 \quad 9 \quad 1 \quad 5 \quad 4'''' \\ \hline 37 \text{ ft. } 2' \quad 2'' \quad 8''' \quad 1'''' \quad 4'''' \\ 12 \quad 12 \\ \hline 26 \quad 16 \\ 12 \quad 144 = \frac{1}{5} \end{array}$$

(29) $37 \text{ c. ft. } 320\frac{1}{5} \text{ c. in.}$

(30) See p. 142 in Treatise, and p. 30 in KEY.

(31)	Good debts	=	£456	18s.	1d.
	4s. in the pound on £360 7s. 10d.	=	72	1	6½
	5s. " " £120 18s.	=	30	3	3
	9s. " " £19 18s.	=	8	19	1½
	His whole assets are worth		£568	2s.	0d.

$$\text{Therefore required sum} = \frac{\cancel{£568}^1 \cancel{2s.} \times 20}{\cancel{£3408}^6 \cancel{12s.}} = 3s. 4d.$$

LIII. EXAMINATION PAPERS, page 181.

This Paper is the first usually given to candidates for Class IV. in the General Post Office, and is too elementary to require solving here.

LIV. EXAMINATION PAPERS, page 181.

This being a specimen of the harder Paper given to those named above, I have worked it out in full. At present twelve 'sums' are given instead of nine.

$$\begin{aligned}
 (1) \quad & 16 \left\{ \begin{array}{l} 4) 2306090 \text{ oz.} \\ 4) 576522 \dots 2 \end{array} \right\} 10 \text{ oz.} \\
 & 28 \left\{ \begin{array}{l} 4) 144130 \dots 2 \\ 7) 36032 \dots 2 \end{array} \right\} 14 \text{ lbs.} \\
 & \quad \quad \quad 4) 5147 \dots 3 \\
 & \quad \quad \quad 2,0) 128,6 \dots 3 \text{ qrs.} \\
 & \quad \quad \quad \quad \quad 64 \text{ tons } 6 \text{ cwt. } 3 \text{ qrs. } 14 \text{ lbs. } 10 \text{ oz.}
 \end{aligned}$$

$$(2) \quad 1 \text{ ton} : 24 \text{ lbs.} :: £7 : \text{required price}$$

$$\text{Therefore required price} = \frac{\cancel{7}^6 \times 7 \times \cancel{20}}{1 \times \cancel{20} \times \cancel{7} \times \cancel{28}_4} = 1s. 6d.$$

(3) £1740 5s. at 14s. 2d.

10s. = $\frac{1}{2}$ of £1	870	2	6	dividend at 10s. in the pound
4s. = $\frac{1}{5}$ "	348	1	0	4s. "
2d. = $\frac{1}{24}$ of 4s.	14	10	$0\frac{1}{2}$	2d. "
	£1232	13s.	$6\frac{1}{2}d.$	14s. 2d. "

(4)

6 fur. 4 pls. 5 yds. 2 ft.
40
244 pls.
$5\frac{1}{2}$
1225
122
1347 yards
3
4043 feet
12
48516 inches

(5) Required rate = $\frac{17 \times 1760 + 1650}{3\frac{3}{4}} = \frac{31570 \times 4}{15} = 8418\frac{2}{3}$

= 4 mls. 1378 $\frac{2}{3}$ yds.

(6) 9 qrs. 2 bus. 1 peck at £2 16s. 8d. per qr.

2 bus. = $\frac{1}{4}$ of 1 pk.
1 pk. = $\frac{1}{8}$ of 2 bus.

25	10	0	cost of 9 qrs.
14	2	"	2 bus.
1	$9\frac{1}{4}$	"	1 pk.

£26 5s. 11 $\frac{1}{4}d.$ Ans.

(7) Number of half-crowns = $\frac{600 \times 10\frac{1}{2}}{2\frac{1}{2}} = \frac{600 \times 21}{5} = 2520$

(8) Required loss = $\frac{2}{3}$ of £750 = £500

- (9) $23 \text{ ac. } 3 \text{ rds. } 15 \text{ pls. at } £1 \text{ } 13s. \text{ } 4d.$
 $\begin{array}{ccc} 2 & 10 & 3 \end{array}$
 $6s. \text{ } 8d. = \frac{1}{8} \text{ of } £2$ $\begin{array}{|lcl} 47 & 18 & 9 \text{ price at } £2 \text{ per acre} \\ 7 & 18 & 11\frac{1}{2} \text{ ,, } 6s. \text{ } 8d. \text{ ,,} \\ \hline £39 & 14s. & 9\frac{1}{2}d. \text{ ,, } £1 \text{ } 13s. \text{ } 4d. \text{ ,,} \end{array}$

LV. EXAMINATION PAPERS, page 182.

- (1) $24 \left\{ \begin{array}{l} 4) 721572 \text{ grs.} \\ 6) 180393 \end{array} \right.$
 $2,0) 3006,5 \text{ .. } 12 \text{ grs.}$
 $12) 1503 \text{ .. } 5 \text{ dwts.}$
 $125 \text{ lbs. } 3 \text{ oz. } 5 \text{ dwts. } 12 \text{ grs. } Ans.$
- (2) $£7 : 3s. :: 1 \text{ ton}$
 $\frac{3 \times 20 \times 4 \times 28}{7 \times 20} = 48 \text{ lbs. } Ans.$
- (3) $£1430 \text{ } 12s. \text{ at } 13s. \text{ } 4d.$
 $6s. \text{ } 8d. = \frac{1}{3} \text{ of } £1$ $\begin{array}{|lcl} 476 & 17 & 4 \text{ div. at } 6s. \text{ } 8d. \text{ in the pound} \\ \hline £953 & 14s. \text{ } 8d. \text{ ,, } & 13s. \text{ } 4d. \text{ ,,} \end{array}$
- (4) $\frac{£485\frac{3}{4} \times 2 \times 2\frac{1}{2}}{100} = \frac{1743 \times 2 \times 5}{100 \times 4 \times 2} = \frac{£174,3}{8,0} = £21 \text{ } 15s. \text{ } 9d. \text{ } Ans.$
- (5) $8\frac{1}{2} + 1\frac{2}{4} + 4\frac{5}{21} + 2\frac{1}{2} = 14 + \frac{6+27+10+17}{42} = 14\frac{60}{42} = 15\frac{3}{7} \text{ } Ans.$
- (6) $8\frac{1}{30} - 3\frac{4}{45} = 8\frac{3}{30} - 3\frac{8}{30} = 4\frac{8}{30} = 4\frac{4}{15} \text{ } Ans.$
- (7) $9\frac{5}{11} \times 4\frac{1}{8} = \frac{104}{11} \times \frac{33}{8} = 39 \text{ } Ans.$
- (8) $72\frac{1}{2} \div 7\frac{1}{4} = \frac{145}{2} \times \frac{4}{29} = 10 \text{ } Ans.$

- (9)
$$\begin{array}{r} .818 \\ 420 \cdot 91 \\ .00093 \\ 7 \cdot 043 \\ \hline 12560 \cdot \\ \hline 12988 \cdot 76693 \text{ Ans.} \end{array}$$
- (11)
$$\begin{array}{r} 757 \cdot 04 \\ 15 \cdot 8 \\ \hline 605632 \\ 378520 \\ 75704 \\ \hline 11961 \cdot 232 \text{ Ans.} \end{array}$$
- (10)
$$\begin{array}{r} 506 \cdot 222 \\ 59 \cdot 87 \\ \hline 446 \cdot 352 \text{ Ans.} \end{array}$$
- (12)
$$\begin{array}{r} 548 \cdot 140 \\ 22 \cdot 0976 \cdot 041 \\ \hline 217256 \text{ nearly} \\ \hline 37140 \end{array}$$
- (13)
$$\begin{array}{r} £2 \cdot 625 \\ 20 \\ \hline 12 \cdot 500 \\ 12 \\ \hline 6 \cdot 00 \\ \\ £2 \text{ } 12s. \text{ } 6d. \text{ Ans.} \end{array}$$
- (14)
$$\begin{array}{r} 12) 5864542 \text{ in.} \\ \hline 3) 488711 \text{ .. } 10 \text{ in.} \\ \hline 162903 \text{ .. } 2 \text{ ft.} \\ 2 \\ \hline 11) 325806 \text{ half-yds.} \\ \hline 4,0) 2961,8 \quad \frac{8}{2} = 4 \text{ yds.} \\ \hline 8) 740 \text{ .. } 18 \text{ pls.} \\ \hline 92 \text{ mls. } 2 \text{ fur. } 18 \text{ pls. } 4 \text{ yds. } 2 \text{ ft. } 10 \text{ in.} \end{array}$$
- (15) Required rate = $\frac{23\frac{3}{4}}{2\frac{1}{4}} = \frac{96}{16} = 9\frac{1}{2} \text{ Ans.}$
- (16)
$$\begin{array}{r} 7 \text{ oz. } 14 \text{ dwts. } 21 \text{ grs. at } £2 \text{ } 13s. \text{ } 4d. \text{ per oz.} \\ 2 \quad 2 \quad 1 \\ \hline 15 \quad 9 \quad 9 \text{ price at } £2 \quad " \\ 5 \quad 8 \quad 8 \quad " \quad 13s. \text{ } 4d. \quad " \\ \hline £20 \quad 13s. \quad 0d. \quad " \quad £2 \text{ } 13s. \text{ } 4d. \quad " \end{array}$$

$$(17) \quad \begin{array}{r} 1.035 \\ 1.035 \\ \hline \end{array}$$

$$5175$$

$$8105$$

$$1035$$

$$1.071225$$

$$1.071225$$

$$5356125$$

$$2142450$$

$$2142450$$

$$1071225$$

$$7498575$$

$$1071225$$

$$\begin{array}{r} 1.147523000625 \\ 9 \end{array} \text{ amount of } \pounds 1 \text{ in 4 years}$$

$$\begin{array}{r} 10327707005625 \\ 300 \end{array} \quad \text{,,} \quad \pounds 9 \quad \text{,,}$$

$$\begin{array}{r} 3098.812101687500 \\ 20 \end{array} \quad \pounds 2700 \quad \text{,,}$$

$$6,242037500$$

$$12$$

$$2,9044500$$

$\therefore \pounds 3098 \text{ } 6s. \text{ } 2.90445d.$ amount required.

$$(18) \quad 12\frac{1}{9} + \frac{7}{15} + 2\frac{7}{30} + \frac{7}{45} = 14 + \frac{20 + 84 + 63 + 28}{180} = 14\frac{195}{180}$$

$$= 15\frac{1}{12} \text{ Ans.}$$

$$5) 9, 15, 20, 45$$

$$4 \times 9 \times 5 = 180$$

$$(19) \quad 4\frac{6}{8} - \frac{1}{2} = 3\frac{3}{4} \text{ Ans.}$$

$$(20) \quad 18\frac{3}{4} \times 1\frac{1}{8} = \frac{75}{4} \times \frac{9}{8} = 35 \text{ Ans.}$$

$$(21) \quad 1\frac{7}{2} \div 8\frac{2}{7} = \frac{29}{22} \times \frac{7}{58} = \frac{7}{44} \text{ Ans.}$$

$$(22) \quad \begin{array}{r} 5004.46 \\ \cdot 579 \\ 1201.043 \\ \hline 5206.082 \end{array}$$

$$(23) \quad \begin{array}{r} 75. \\ 19.9876 \\ \hline 55.0124 \end{array}$$

$$(24) \quad \begin{array}{r} 45.267 \\ 7.045 \\ \hline 226335 \\ 181068 \\ 316869 \\ \hline 318.906015 \end{array}$$

$$(25) \quad \begin{array}{r} 15.960 \\ 13 \quad 3192 \\ \hline 1 \quad 245.53846 \end{array}$$

$$(26) \quad \frac{18s. 8\frac{1}{2}d.}{2s. 2d.} = \frac{224.25}{26} = \frac{112.125}{13} = 8.625 \text{ Ans.}$$

$$(27) \quad \begin{array}{r} 5 \text{ acres } 13 \text{ poles} \\ 4 \\ \hline 20 \text{ roods} \\ 40 \\ \hline 813 \text{ poles} \\ 30\frac{1}{2} \\ \hline 24390 \\ 203\frac{1}{2} \\ \hline 24593\frac{1}{2} \text{ yards} \\ 9 \\ \hline 221339\frac{1}{2} \text{ square feet} \end{array}$$

$$(28) \quad 4\frac{1}{8} \text{ cwt.} : 195\frac{1}{4} \text{ lbs.} :: 21 \text{ guineas} : \text{required price}$$

$$\therefore \text{Required price} = \frac{71 \times 7 \times 21}{4 \times 33 \times 20 \times 112} = \frac{149,1}{16,0} = 29 \text{ } 6s. 4$$

-) 34 c. yds. 3 ft. 288 in. at £3 6s. 9d. per yd.

	2						
	6	13	6	price of	2	yds.	
	17						
3 ft. = $\frac{1}{3}$ of 1 yd.	113	9	6		34		
288 in. = $\frac{1}{18}$ of 3 yds.	0	7	5		3	ft.	
	0	0	41		288	in.	
	£113	17	31				

-) Required time = the given sum divided by its interest for

$$\text{one year} = \frac{\text{£}2220}{\frac{2220 \times 6}{100}} = \frac{2220 \times 100}{2220 \times 6} = 16\frac{2}{3} \text{ years}$$

- $$.) \frac{7}{16} + 6\frac{5}{48} + 2\frac{5}{8} + \frac{13}{24} = 8 + \frac{21+5+40+26}{48} = 8 + \frac{92}{48} = 9\frac{1}{2} \text{ Ans.}$$

- $$b) \quad 11\frac{3}{44} - 7\frac{15}{99} = 11\frac{3}{44} - 7\frac{30}{99} = 3\frac{17}{44} \text{ Ans.}$$

- $$i) \quad \frac{19}{20} \times 11\frac{1}{9} \times 3\frac{2}{3} = \frac{19}{20} \times \frac{100}{9} \times \frac{135}{38} = \frac{15}{2} = 7\frac{1}{2} = 37\frac{1}{2}$$

- $$7\frac{7}{11} + 3\frac{3}{8} = \frac{84}{11} \times \frac{55}{168} = 2\frac{1}{2} \text{ Ans.}$$

(37) 974.01
7.045

$$\begin{array}{r} \text{i)} \quad \begin{array}{r} 1824 \cdot 2764 \\ 176 \cdot 09032 \\ \cdot 47 \\ \hline 2000 \cdot 83672 \end{array} \qquad \begin{array}{r} 487005 \\ 389604 \\ 681807 \\ \hline 6861 \cdot 90045 \end{array} \end{array}$$

- 3) $\frac{872-70032}{7-20147} = \frac{(38) 2470-0000}{1729} = 1.765 (0.00071)$
865-49885 360

$$(39) \quad \frac{1s. 2d.}{12s. 8\frac{1}{2}d.} = \frac{\overset{2}{14}}{\underset{21.75}{157.75}} = \frac{8}{87} = .09195... \text{ Ans.}$$

$$\begin{array}{r} 21.75 \overline{) 200} \\ 435 \\ 87 \overline{) 800} \quad (.09195... \\ 783 \\ \hline 170 \\ 87 \\ \hline 830 \\ 783 \\ \hline 470 \\ 435 \\ \hline \end{array}$$

LVI. EXAMINATION PAPERS, page 183.

The Questions in this set are exactly like those above.

LVII. EXAMINATION PAPERS, page 184.

$$\begin{array}{lcl} (1) \text{ Price of 21 oz. pure gold} & = £3 \ 17s. \ 10\frac{1}{2}d. \times 21 & = £81 \ 15s. \ 4\frac{1}{2}d. \\ \text{,, 2 oz. alloy} & = 2 \times 4\frac{1}{2}d. & = \underline{\quad 9 \quad} \\ & & £81 \ 16s. \ 1\frac{1}{2}d. \end{array}$$

Since value of alloy in £81 16s. 1½d. = 9d., we have

$$£81 \ 16s. \ 1\frac{1}{2}d. : £1000 :: 9d. : \text{required value}$$

$$\therefore \text{Required value} = \frac{1000 \times 9 \times 2}{\underset{4363}{39267}} = 9s. \ 2\frac{70}{4363}d. \text{ Ans.}$$

(2) See (28) and (29), p. 180.

$$\begin{aligned} (3) \text{ Required amount} &= £1500 \times 1.0125^5 = £1500 \\ &\times 1.0509453369140625 = £1576 \ 8s. \ 4.3212890625d. \end{aligned}$$

$$(4) \text{ Required interest} = \frac{1000 \times 5}{97\frac{1}{8}} = £51 \text{ } 9s. \text{ } 7\frac{5}{8}d.$$

(5) (7) to (9). See Treatise.

$$(6) \text{ Number of men} = 50 \times 4 \times 2 + 42 \times 4 \times 2 = 736.$$

LVIII. MISCELLANEOUS QUESTIONS, page 187.

$$(1) \quad 110 : 15.27 :: £23 : \text{required value}$$

$$\therefore \text{Required value} = \frac{15.27 \times £23}{110} = £3 \text{ } 3s. \text{ } 10.2763d.$$

(2) See Ex. 12, p. 180.

(3) See Ex. 1, p. 185.

(4) See (17), p. 102.

(5) and (6). See (28) and (29), p. 180.

$$(7) \text{ Required decimal} = \frac{5}{8} \times \frac{27}{2} \times \frac{1}{\frac{9}{71}} = \frac{45}{16 \times 7} = \frac{2.8125}{7} \\ = .4017857142 \text{ } Ans.$$

$$(8) .38246 \times 10\frac{1}{2}s. = 4.01583s. = 4s. \text{ } 0.18996d. \text{ } Ans.$$

(9) See (27), p. 180.

$$(10) \frac{3}{8} \times \frac{3}{8} \times 8 \text{ fur.} - \frac{3}{8} \times \frac{1}{20} \times \frac{3}{7} = \frac{3}{8} - \frac{3}{83} = \frac{49}{83} = 25\frac{5}{83} \text{ } pls.$$

$$(11) \text{ Required cost} = \frac{25 \times 20 \times 51d.}{2\frac{1}{2} \times 3 \times 240} = £14 \text{ } 3s. \text{ } 4d.$$

(12) See Ex. 12, p. 108.

(13) See (27), p. 180.

$$(14) 175 : 144 :: 221\frac{3}{8} \text{ lbs.} : \text{required lbs. Avoir.}$$

$$\therefore \text{Required lbs.} = \frac{\begin{array}{r} 37 \\ 185 \\ 1295 \\ 144 \times 6475 \end{array}}{\begin{array}{r} 175 \times 288 \\ 35 \\ 5 \end{array}} = 18\frac{1}{2} \text{ lbs.}$$

.. 5) See (37), p. 129.

(16) See Ex. 3, p. 120.

(17) See p. 90.

(18) See p. 91.

$$(19) \text{ Required thickness} = \frac{\text{the solidity}}{\text{given surface}} = \frac{56 \text{ c. ft. } 1044 \text{ in.}}{29 \text{ ft. } 3 \text{ in.} \times 25 \text{ ft. } 4 \text{ in.}} \\ = \frac{27812}{108764} = 1\frac{1}{11}$$

$$(20) \quad \left. \begin{array}{l} 100\frac{3}{8} : 99 \\ 3 \times 240d. : 365 \times 2\frac{1}{2}d. \end{array} \right\} :: 100 \text{ first income} : \text{second income}$$

$$\text{therefore second income} = \frac{99 \times 5 \times 365 \times 100 \times 8}{2 \times 3 \times 240 \times 808} = 125$$

$$\text{therefore increase per cent.} = 125 - 100 = 25$$

(21) The number of men, women, and children are as 1, 2, 3

$$\therefore \frac{1}{8} \text{ of } 336 = 56 \text{ number of men}$$

$$56 \times 2 = 112 \text{ children, and } 56 \times 3 = 168 \text{ women}$$

$$\begin{array}{ll} \text{If every woman cost} & 1d. \\ \text{" man "} & 1\frac{1}{3}d. \\ \text{" child " } \frac{1}{3} \text{ of } 2\frac{1}{3}d. & = \frac{2}{3}d. \end{array}$$

$$\therefore 56 \text{ men cost } 56 \times 1\frac{1}{3} = 74\frac{2}{3}$$

$$112 \text{ women " } 112 \times 1 = 112$$

$$168 \text{ children " } 168 \times \frac{2}{3} = 130\frac{2}{3}$$

$$\text{Cost of all} = 317\frac{1}{3}$$

$$\therefore \left. \begin{array}{l} 317\frac{1}{3} : 74\frac{2}{3} \\ 56 \text{ men} : 1 \text{ man} \\ 31 \text{ days} : 1 \text{ day} \end{array} \right\} :: \text{£}83 \text{ } 6s. : \text{cost of a man for 1 day}$$

$$\therefore \text{ Required cost} = 23\frac{2}{3}d.$$

$$\text{A woman's} = 23\frac{2}{3}d. \times \frac{3}{4} = 23\frac{1}{4}d.$$

$$\text{A child's} = 43\frac{2}{3} \div 3 = 11\frac{2}{3}d.$$

(22) and (23). See (28) and (29), p. 180.

(24) See Ex. 8, p. 105.

(25) See Ex. 7, p. 104.

(26) See Ex. 4, p. 186.

$$(27) \quad \left. \begin{array}{l} 5 : 32 \\ 12 : 24 \end{array} \right\} :: 90s. : \text{required sum}$$

$$\therefore \text{ Required sum} = \frac{32 \times 24 \times 90}{5 \times 12 \times 20} = \text{£}57 \text{ } 12s.$$

$$(28) \quad \left. \begin{array}{l} 2 : 1 \\ 1 : \frac{1}{4} \end{array} \right\} :: £57 \ 12s. : \text{required result}$$

$$\therefore \text{Required result} = \frac{£57 \ 12s. \times 5}{2 \times 4} = £36$$

$$(29) \text{ See (3), p. 184.}$$

$$(30) \text{ See (8), p. 99.}$$

$$(31) \text{ See (22), p. 101.}$$

$$(33) \text{ See p. 167.}$$

$$(34) \quad \left. \begin{array}{l} 365 \text{ days} : 390 \text{ days} \\ £100 : £97\frac{1}{8} \end{array} \right\} :: £95 : \text{required amount}$$

$$\therefore \text{Required amount} = \frac{390 \times 781 \times 95}{8 \times 100 \times 365} = £99 \ 1s. \ 11\frac{4}{3}d.$$

$$(35) \quad \text{Cost} = 6948\frac{1}{2} \times 48\frac{7}{8}d. = £1415 \ 1s. \ 6\frac{3}{4}d.$$

$$\text{Total gain} = 6948\frac{1}{2} \times \frac{5}{8}d. = £16 \ 1s. \ 8\frac{5}{8}d.$$

Issued for the sum of these results.

$$(36) \text{ Amount of } £1 \text{ in 5 years at 5 per cent.} = 1.05^5 \\ = 1.2762815625$$

$$\therefore \text{Required amount} = £100\frac{1}{2} \times 1.2762815625 \\ = £128 \ 1s. \ 0.860025d.$$

$$(37) \text{ See Ex. 1, p. 125.}$$

$$(38) \text{ See (2), p. 156.}$$

$$(39) \text{ See (39), p. 183.}$$

$$(40) \text{ See Ex. 1, p. 157.}$$

$$(41) \text{ See Ex. 2, p. 155.}$$

$$(42) \text{ See Ex. 4, p. 159.}$$

$$(43) \quad \frac{1}{4} \text{ of } 100 = 25 \text{ the number of E. C. and Pres. in every 100} \\ \text{of the population, and } \frac{2}{3} \text{ of } 25 = 10 \text{ the Pres.}$$

$$75 : 100 :: 10 : \text{required percentage}$$

$$\therefore \frac{100 \times 10}{75} = 13\frac{1}{3} \text{ Ans.}$$

$$(44) \quad \left. \begin{array}{l} 3\frac{1}{2} : 3 \\ 240 : 231 \end{array} \right\} :: 100 : \text{required price}$$

$$\therefore \text{Required price} = \frac{3 \times 100 \times 231 \times 2}{7 \times 240} = 82\frac{1}{2}$$

$$(45) \text{ Retail price} = \frac{(100 + 9 + 21) \times 12s. \ 6d.}{100} = 16s. \ 3d.$$

(46) Whole number of 1st class = 7175622

Do. of 2nd and 3rd „ = 57013659

$$\therefore (7175622 \times 100) \div 57013659 = 12.58...$$

(47) Required gain = $\frac{.075 \times 7 \times 24 \times 60}{100} = 7.56$ minutes

(48) See (1), p. 132.

(49) See (18), p. 100.

$$(50) \quad \frac{3}{7} \times \frac{41}{9} \times \frac{3}{37} \times \frac{37}{11} \times \frac{7}{82} \times \frac{11}{12} = \frac{1}{24}$$

(51) See (3), p. 165.

(52) and (53). See p. 172.

(54) Average increase = $(£365 \text{ 14s. 1d.} - £283 \text{ 17s. 10d.}) \div 21$
 $= £3 \text{ 17s. 11d.}$

$$\therefore \text{Required average} = £293 \text{ 17s. 4d.} + £3 \text{ 17s. 11d.}$$

$$= £297 \text{ 15s. 3d.}$$

(55) $102\frac{2}{3} : £126\frac{2}{3} :: 2\frac{2}{3} : \text{discount}$

$$\therefore \text{Discount} = \frac{380 \times 8 \times 3}{3 \times 3 \times 308} = £3 \text{ 5s. } 9\frac{4}{7}\text{d.}$$

$$\text{Interest} = \frac{£126\frac{2}{3} \times 4 \times 8}{1200} = £3 \text{ 7s. } 6\frac{2}{3}\text{d.}$$

$$\therefore \text{Difference} = £3 \text{ 7s. } 6\frac{2}{3}\text{d.} - £3 \text{ 5s. } 9\frac{4}{7}\text{d.} = 1\text{s. } 9\frac{13}{21}\text{d.}$$

(56) See (36), p. 189.

(57) See Ex. 3, p. 18.

$$(58) \text{ Population in 1801} = \frac{21121967 \times 100}{193.5} = 10915745.219...$$

$$(59) \quad \frac{\frac{2}{5} \times \frac{23}{4} - \frac{3}{8} \times \frac{17}{4}}{\frac{7}{8} \times \frac{3}{7} \times \frac{21}{4} - \frac{5}{8} \times \frac{4}{15} \times \frac{11}{3}} = \frac{\frac{23}{10} - \frac{51}{32}}{\frac{63}{32} - \frac{11}{18}} = \frac{113}{100} \times \frac{18}{391} = \frac{1017}{1955}$$

(60) See Ex. 1, p. 91.

(61) See Ex. 8, p. 141.

(62) See Ex. 2, p. 170.

$$(63) \quad \frac{5}{27} \times \frac{6}{27} \times 1760 \text{ yds.} = \frac{160}{27} = 5 \text{ yds. } 2 \text{ ft. } 9\frac{1}{3} \text{ in.}$$

$$(64) \quad * 15 : 60 :: 1 : 4$$

$$\text{Then 1 at } 82 = 82s.$$

$$,, \quad 4 \quad ,, \quad 500 = 200s.$$

$$\text{Bought 5 dozen for } 282s.$$

$$\text{Sold 5 } ,, \quad ,, \quad 350s.$$

$$\therefore \frac{350 \times 100}{282} = £124 \ 2s. \ 3\frac{1}{4}d.$$

$$\text{Gain per cent.} = £124 \ 2s. \ 3\frac{1}{4}d. - 100 = £24 \ 2s. \ 3\frac{1}{4}d.$$

$$(65) \text{ See Ex. 1, p. 165.}$$

$$(66) \quad (3 \times 20s. + 11 \times 12s. \ 6d. + 19 \times 7s. \ 1\frac{1}{2}d. + 17 \times 3s. \ 4\frac{1}{2}d. + 2 \\ \times 1s. \ 6d.) + 58 = 393s. \ 3d. + 58 = 6s. \ 9\frac{1}{2}d. \ \text{Ans.}$$

$$(67) \text{ See Ex. 2, p. 155.}$$

$$(68) \quad 140 : 100 :: 20 \times 28 : \text{required number}$$

$$\therefore \text{Required number} = \frac{20 \times 28 \times 100}{140} = 400$$

$$(69) \text{ Average in 1852} = \frac{55331 + 8271 + 3999}{5433.9 + 961.4 + 680.4} = \frac{67601}{7075.7} \\ = 9.553...$$

$$\text{Average in 1853} = \frac{66267 + 8979 + 5163}{7544.2 + 977.9 + 786.9} = \frac{70409}{9309} \\ = 8.637...$$

$$(70) \text{ See (32), p. 164.}$$

$$(71) \text{ See Ex. 7, p. 187.}$$

$$(72) \text{ See Ex. 4, p. 159.}$$

$$(73) \text{ Present worth} = £1936 \ 18s. - £207 \ 10s. \ 6d. = £1729 \ 7s. \ 6d.$$

$$\left. \begin{array}{l} £1729\frac{3}{8} \quad : \quad £100 \\ 3 \text{ yrs.} \quad : \quad 1 \text{ yr.} \end{array} \right\} :: £207 \ 10s. \ 6d. : \text{required rate}$$

$$\therefore \text{Required rate} = \frac{100 \times 207\frac{1}{2} \times 8}{3 \times 13835} = 4$$

$$(74) \text{ See (59), p. 181.}$$

(75) £272 : £85 :: 320 guineas : 100 + required rate

$$\therefore 100 + \text{required rate} = \frac{85 \times 320 \times 21}{272 \times 20} = 105$$

$$\therefore \text{Required rate} = 105 - 100 = 5 \text{ per cent. gain.}$$

(76) Gain on 4s. 4d. + 6d. = 9d.

$$\therefore 4s. 10d. : 100 :: 9d. : \text{required gain per cent.}$$

$$\therefore \text{Required gain} = \frac{100 \times 9}{58} = 15\frac{1}{2}\%$$

(77) See (27), p. 180.

(78) See (73), above.

(79) See Ex. 8, p. 152.

(80) See (28), p. 180.

(81) Required side = $\sqrt{513 \text{ yds. 1 ft. 11 in.} \times 1628 \text{ yds. 0 ft. 11 in.}}$
 $= \sqrt{18491 \times 58619} = \sqrt{1083923929} = 32923 \text{ in.}$
 $= 914 \text{ yds. 1 ft. 7 in.}$

$$(82) \frac{3}{7} \times 1\frac{1}{8} + 2\frac{1}{8}\frac{5}{8} \times \frac{1}{4} = \frac{3}{7} \times \frac{7}{8} + \frac{2135}{990} \times \frac{11}{14} = \frac{1}{2} + \frac{11}{14}$$

$$= 2\frac{1}{8} \text{ Ans.}$$

(83) See Ex. 5, p. 186.

(84) 1 day true time = 24 × 60 = 1440 minutes

1 „ on the fast clock = 1442 „

1 „ „ slow clock = 1436 „

$$\therefore 1442 : 1436 :: 12 : \text{required time}$$

$$\therefore \text{Required time} = \frac{1436 \times 12}{1442} = 11 \text{ days 22 hrs. } 48\frac{1}{2} \text{ m.}$$

(85) $\left. \begin{array}{l} 1 \text{ gall.} : 1 \text{ pint} \\ 1728 : 277.27 \end{array} \right\} :: 62.42 \text{ lbs.} : \text{required weight}$

$$\therefore \text{Required weight} = \frac{222.27 \times 62.42}{1728 \times 8} = 1.25 \text{ lbs.}$$

(86) See (27), p. 180. (87) and (88). See (28), p. 180.

(89) Taking the share of a woman as the standard

share of 64 women = 64

„ 20 men = 40

„ 96 children = 32

136

$\therefore 136 : 40 \left. \vphantom{\begin{matrix} 136 \\ 20 \end{matrix}} \right\} :: £3000 : \text{a man's share}$

$\therefore \text{A man's share} = \frac{£3000 \times 40}{136 \times 20} = £44 \text{ } 2s. \text{ } 4\frac{4}{17}d.$

(90) and (91). See p. 95. (92) See p. 95.

(93) $\frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} : \frac{1}{3} :: £177 \text{ } 7s. \text{ } 0\frac{3}{4}d. : \text{required term, corresponding to } \frac{1}{3}, \text{ that is, } \frac{£177 \text{ } 7s. \text{ } 0\frac{3}{4}d. \times 60}{57 \times 3} = £62 \text{ } 4s. \text{ } 7d.$

The other terms may be found in a similar manner.

(94) $4.03 \div .1407 = 4\frac{1}{30} \times \frac{9990}{1406} = \frac{121}{30} \times \frac{9990}{1406} = \frac{1089}{38}$

$\begin{array}{r} 9 \\ 333 \\ 30 \overline{) 9990} \\ \underline{30} \\ 6990 \\ \underline{60} \\ 990 \\ \underline{90} \\ 90 \\ \underline{90} \\ 0 \end{array}$

$= 28.6578, \text{ \&c. } Ans.$

(95) $£532\frac{2}{3} : £100 \left. \vphantom{\begin{matrix} 532 \\ 4\frac{1}{2} \end{matrix}} \right\} :: 1 \text{ year} : \text{required time}$

$\therefore \text{Required time} = \frac{100 \times \frac{27}{243} \times 7 \times 7}{\frac{3726}{1863} \times 9 \times 7} = 1\frac{31}{81} \text{ year.}$

$\begin{array}{r} 27 \\ 243 \overline{) 3726} \\ \underline{243} \\ 1296 \\ \underline{1296} \\ 0 \end{array}$

(96) $13\frac{1}{2} : 14 :: 2s. \text{ } 3d. : \text{required price}$

$\therefore \text{Required price} = 2s. \text{ } 4d.$

(97) See (2), p. 182. (98) See Ex. 4, p. 159.

(99) See Ex. 2, p. 155. (100) See Ex. 2, p. 156.

(101) See (13), p. 157.

(102) See Ex. 7, p. 102.

(103) See (32), p. 154.

(104) See Ex. 2, p. 155.

$$\begin{array}{rcl}
 (106) & A=2100 \times 12=25200 \\
 & B=1500 \times 12=18000 \\
 & C=2700 \times 8=21600 \\
 & \quad \underline{6300} \quad \quad \underline{64800}
 \end{array}$$

$$\therefore 64800 : 25200 :: \frac{£6300}{100} : 245 \text{ A's share}$$

The shares of *B* and *C* can be found in the same manner.

$$\begin{aligned}
 (107) \text{ His gain} &= \text{the difference between the amount of present} \\
 &\text{selling price of the cows for 1 yr. at 5 per cent. and } £50 \\
 &= \frac{325 \times 15 \times 105}{100} - 5000 = 5118\frac{3}{4} - 5000 = £118\frac{3}{4} \text{ Ans.}
 \end{aligned}$$

Some take the *present* difference.

$$(108) 26 \text{ hrs.} : 10 \text{ hrs.} :: 10' : 3\frac{1}{3}'$$

$$\therefore 10 + 3\frac{1}{3} = 13\frac{1}{3}' \text{ Ans.}$$

$$(109) \text{ Quantity of stock} = \frac{5460 \times 100}{91} = £6000$$

$$\text{Gain on } £200 = 2 \times 2\frac{1}{2} = £5$$

$$\text{Loss on } £5800 = 58 \times 6 = 348$$

$$\therefore \text{Total loss} = 348 - 5 = £343$$

Now difference in income = second income - first income

$$\begin{aligned}
 &= \frac{(\pounds 5460 - \pounds 343) \times 4\frac{1}{2}}{102} - \frac{6000 \times 3}{100} = \pounds 225\frac{3}{4} - 180 \\
 &= \pounds 45 \text{ 15s. gain.}
 \end{aligned}$$

$$(110) \text{ If 100 be total cost: then, since } 101 - 95 = 6$$

$$\left. \begin{array}{l} 6 : 8 \\ 125 : 100 \end{array} \right\} :: \pounds 100 : \text{Ans.}$$

$$\therefore \text{Ans.} = \frac{100 \times 3 \times 100}{6 \times 125} = \pounds 40.$$

(111) See p. 132, Ex. 1.

(112) Average gain in 176 days

$$\begin{aligned}
 &= \left\{ \left(\frac{5}{7} + 1\frac{3}{16} + \frac{3}{4} \right) - \left(1\frac{4}{5} + \frac{4}{3} \right) \right\} \times 175 \div 5 \\
 &= \left(\frac{186}{70} - \frac{349}{420} \right) \times \frac{176}{5} = \frac{134992'}{126000} = 1' 4.28190476'' \text{ Ans.}
 \end{aligned}$$

(113) 16 men in 16 days do $\frac{1}{2}$ of $\frac{1}{2} = \frac{1}{4}$ $\therefore$ 16 men in 24 days do $1\frac{1}{2} \times \frac{1}{4} = \frac{1}{2}$

$$\frac{1}{4} : \frac{1}{2} :: 16 : 32 \text{ Ans.}$$

(114) See (8), p. 138.

(115) See Ex. 7, p. 140.

(116) and (117). See Ex. 5, p. 139.

(118) See p. 90.

(119) See Ex. 6, p. 139.

(120) £45 18s. 9d. = 11025d.; then $\sqrt{11025} = 105$ Ans.

(121) See (2), p. 127.

(122) See p. 142.

(123) See (17), p. 182.

(124) See (10), p. 99.

$$\begin{aligned}
 (125) \text{ Required difference} &= \frac{£12000 \times 5}{103\frac{3}{4}} - \frac{£12000 \times 3}{90\frac{5}{8}} \\
 &= \frac{£12000 \times 5 \times 4}{415} - \frac{£12000 \times 3 \times 8}{725} \\
 &= \frac{£1392000 - £956160}{2407} = £181 \text{ 1s. } 5\frac{901}{2407}d.
 \end{aligned}$$

(126) See (7), p. 97.

(127) See (18), p. 100.

(128) See (29), p. 100.

(129) See Ex. 6, p. 123.

(130) See (39), p. 183.

(131) See Ex. 1, p. 125.

(132) See Ex. 3, p. 155.

(133) and (134). See (28), p. 180.

(135) See (22), p. 100.

$$(136) \text{ Expense of production} = 3900 \times 2s. 4\frac{1}{2}d. = £463 \ 2s. 6d.$$

$$\frac{1}{3} \text{ of } 3900 = \frac{3900}{3}$$

$$= 1300$$

$$25 \text{ per cent. of } 3600 = \frac{3600}{4}$$

$$= 900$$

$$2700 \text{ at } 7s. 6d. = £1012 \ 10s.$$

$$\therefore \text{Ans.} = (£1012 \ 10s. - £463 \ 2s. 6d.) \div 2 = £274 \ 13s. 9d.$$

$$(137) \text{ See (17), p. 182.}$$

$$(138) \text{ See Ex. 1, p. 135.}$$

$$(139) \text{ See (37), p. 100.}$$

$$(140) \text{ Required time} = \frac{£15 \ 2s. 6d. \times 105}{£75 \ 12s. 6d.} = 21 \text{ days.}$$

$$(141) \text{ Divide in ratios of } 152, 19, 29, \text{ as in p. 124.}$$

$$(142) \text{ Required amount} = \frac{£152 \ 7s. 9d. \times 100}{365d.} = £10020.$$

$$(143) \text{ See (38), p. 130.}$$

$$(144) \text{ See (39), p. 130.}$$

$$(145) \text{ See (14), p. 188.}$$

$$(146) \text{ Time by coach} = 69 + 9 = 7\frac{2}{3} \text{ hrs.}$$

$$\therefore \text{ „ train} = 7\frac{2}{3} - 4 = 3\frac{2}{3} \text{ „}$$

$$\text{Required ratio } 3\frac{2}{3} : 7\frac{2}{3} \text{ or } 11 : 23$$

$$(147) \text{ Required difference} = B's \text{ net income} - A's \text{ net income}$$

$$= \left(\frac{£33075 \times 4}{94\frac{1}{2}} - \frac{£33075 \times 3}{87\frac{1}{2}} \right) \times \frac{3\frac{2}{3}}{1\frac{1}{3}} = (£1400 - £1134) \times \frac{4}{3} = £248 \ 5s. 4d.$$

$$(148) \text{ Required value} = 1\frac{7}{4} = 1 \text{ lb. } 2 \text{ oz. } 11 \text{ dwts. } 16 \text{ grs.}$$

$$(149) \text{ See (7), p. 97.}$$

$$(150) \text{ See (68), p. 192.}$$

$$(151) \text{ See Ex. 1, p. 135.}$$

$$52) \text{ Each } £100 \text{ railway stock} = £108 \text{ cash} = \frac{108 \times 100}{91\frac{1}{8}} \text{ Govern-}$$

$$\text{ment stock} = \frac{108 \times 1000 \times 95\frac{3}{8}}{91\frac{1}{8} \times 1000} \text{ cash} = 113\frac{1}{27}$$

$$\therefore \text{Gain on every } £100 \text{ railway stock} = 113\frac{1}{27} - 109 = £4\frac{1}{27}$$

$$\therefore \text{Amount of stock} = \frac{109 \times £100}{4\frac{1}{27}} = £2700$$

$$53) \text{ Circuit of room} = (19 \text{ ft. } 10\frac{1}{2} \text{ in.} + 16 \text{ ft. } 1\frac{3}{4} \text{ in.}) \times 2 \\ = 73 \text{ ft. } 6\frac{1}{2} \text{ in.}$$

$$\therefore \text{Required cost} = \frac{73 \cdot 5416 \times 10 \cdot 25 \times 51d.}{9 \times 12 \times 20} = £6 \text{ } 9s. \text{ } 10d.$$

$$54) \text{ See (17), p. 182.} \quad (155) \text{ See Ex. 9, p. 141.}$$

$$56) \quad £157 \text{ } 5s. \text{ } 10d. - £7 \text{ } 4s. \times 6 = £114 \text{ } 1s. \text{ } 10d.$$

$$\therefore \text{Required sum} = \left(\frac{£157 \text{ } 5s. \text{ } 10d. \times 104}{100} - £114 \text{ } 1s. \text{ } 10d. \right) \\ \div 8 = £15 \text{ } 0s. \text{ } 11\frac{1}{2}d.$$

$$57) \text{ See Ex. 1, p. 152.} \quad (158) \text{ See (39), p. 130.}$$

$$59) \text{ See (3), p. 165.} \quad (160) \text{ See Ex. 1, p. 165.}$$

$$61) \text{ From the question 6 times the stride of first} = 7 \text{ times the} \\ \text{stride of second}$$

$$\therefore \text{Gain of first over second} = 7 \times 5 - 6 \times 4 = 11 \text{ in } 35$$

$$\therefore \text{Required gain} = \frac{4 \times 11 \times 1760 \text{ yds.}}{35} = 2212\frac{4}{7} \text{ yards.}$$

$$62) \text{ See (4), p. 165.} \quad (163) \text{ See (22), p. 100.}$$

$$64) \text{ See Ex. 1, p. 118.} \quad (165) \text{ See Ex. 1, p. 135.}$$

$$66) \text{ See (3), p. 97.} \quad (167) \text{ See (25), p. 183.}$$

$$68) \text{ See (7), p. 128.} \quad (169) \text{ See (3), p. 97.}$$

(170) See (12), p. 86. (171) See (3), p. 97.

(172) See (17), p. 182.

(173) See Ex. 6 and 7, p. 152.

(174) See (105), above.

(175) The sum = $(£210\frac{3}{20} \times 5\frac{5}{12}) + 3\frac{1}{4} = £350\ 5s.$

(176) See (59), above. (177) See (22), p. 100.

(178) See (7), p. 128. (179) See (48), p. 111.

(180) See (20), p. 128. (181) See Ex. 7, p. 104.

(182) See (22), p. 100. (183) See (18), p. 100.

(184) See (17), p. 182. (185) See (17), p. 68.

(186) See p. 90. (187) See (22), p. 100.

(188) Required number $\frac{(88\frac{3}{8} \times 1000)}{100 \times 8\frac{3}{4}} = 101.$

(189) See (11), p. 127. (190) See (36), p. 171.

(191) See Ex. 6, p. 123.

(192) Required cost = $\frac{55\frac{1}{2} \times 10 \times 81d.}{2\frac{1}{3} \times 3 \times 12 \times 240} = \frac{999}{448} = £2\ 4s. 7\frac{5}{8}d.$

(193) See (73), above. (194) and (195). See p. 88.

(196) See (7), p. 97.

(197) Quantity of stock bought = $\frac{£1911 \times 100}{79\frac{5}{8}} = £2400$

$\therefore$ Required price = $\frac{1}{8} + \frac{ (£1911 + 150) }{24} = 86.$

(198) See Ex. 1, p. 164. (199) See Ex. 1, p. 165.

(200) See (26), p. 100. (201) See Ex. 1, p. 165.

$$(202) \text{ Required number} = \left(\frac{38+74}{2} \times 35 \times \frac{3}{4} \times 8 \times 40 \times \frac{1}{2} \times 3 \right) \\ \div 27 = 287466\frac{2}{3}$$

$$(203) \text{ First gains } \frac{1}{2} \text{ a mile per hour on second; } \therefore \text{ he will gain } \\ 6-4=2 \text{ miles in 4 hours}$$

$$\therefore \text{ Required distance} = 5 \times 4 + 3\frac{1}{2} \times 4 = 34 \text{ miles.}$$

$$(204) \text{ See (17), p. 182.}$$

$$(205) \text{ Greater} - 18 : 18 - \text{less} :: 2 : 3$$

$$\therefore 3 \text{ greater} - 54 = 36 - 2 \text{ less}$$

$$3 \text{ greater} + 2 \text{ less} = 90; \text{ but greater} + \text{less} = 34$$

$$\therefore 2 \text{ greater} + 2 \text{ less} = 68$$

$$\text{Greater} = 22, \text{ and less} = 12$$

$$(206) \text{ See (35), p. 60.}$$

$$(207) \text{ She receives } 3\frac{3}{4} \times 5 - 12 = 6\frac{3}{4} \text{ tons an hour}$$

$$\therefore \text{ She will sink in } 60 \div 6\frac{3}{4} = 8\frac{8}{9} \text{ hrs.}$$

$$\therefore \text{ Required rate} = 40 \div 8\frac{8}{9} = 4\frac{1}{2} \text{ miles per hour.}$$

$$(208) \text{ A sidereal hour} = 23 \text{ hrs. } 56' 4.09'' \div 24 = \frac{8616409''}{2400}$$

$$\text{And since } 24 \text{ hrs.} = 86400''$$

$$\text{Required number} = 86400'' \div \frac{8616409}{2400} = 24 \text{ hrs. } 3' 56.55'' \dots$$

$$(209) \text{ See Ex. 8, p. 152.}$$

$$(210) \text{ Cost} = (6 \cdot 4\frac{2}{7} \times 36 \times 1\frac{11}{10} \times 36) \times 25s.$$

$$= \frac{\overset{5}{450} \times \overset{9}{36} \times \overset{23}{161} \times 36 \times \overset{5}{25}}{\underset{2}{70} \times \underset{4}{90} \times 20} = £18630$$

$$(211) \text{ See (59), p. 131.}$$

$$(212) \text{ Interest} = £607 \text{ 18s.} - (340 + 220) = £47 \text{ 18s.}$$

$$\text{Interest on } £220 \text{ for 1 yr. at 5 per cent.} = £11$$

$$\therefore \text{Interest of all after first year} = £47 \text{ 18s.} - £11 = £36 \text{ 18s.}$$

$$\text{Interest of } £220 \text{ at 5 per cent.} + £340 \text{ at 4 per cent.} \\ = £24 \text{ 12s. for 1 year}$$

$$\therefore \text{Required time of second} = £36 \text{ 18s.} \div £24 \text{ 12s.} = 1\frac{1}{2} \text{ yrs.,} \\ \text{and first} = 2\frac{1}{2} \text{ yrs.}$$

$$(213) C \text{ paid } \frac{£605 \frac{9}{10} \times 100}{106} = \frac{£30295}{53}$$

$$B \text{ ,, } \frac{£30295}{53} - \frac{203}{5} = \frac{£140716}{265}$$

$$A \text{ ,, } \frac{£140716 \times 100 \times 2}{265 \times 209 \times 12 \times 126} = \frac{£703580}{2093553} = 6\text{s. } 8\frac{1}{2}\text{d. nearly.}$$

$$(214) \text{ See (38), p. 130.}$$

$$(215) \text{ See Ex. 6, p. 123.}$$

$$(216) \quad 104\frac{1}{2} : 110 :: 34\text{s. } 6\text{d.} : \text{required rate}$$

$$\therefore \text{Required rate} = \frac{10}{19} \times \frac{110 \times 69 \times 2}{209 \times 2} = 36\text{s. } 31\frac{5}{9}\text{d.}$$

$$(217) \text{ See (2) and (5), p. 165.}$$

$$(218) \text{ Gain in 3 months} = £412 \text{ 10s.} - £375 = £37 \text{ 10s.}$$

$$\therefore \text{Gain per cent.} = \frac{£37 \text{ 10s.} \times 100 \times 4}{375} = 40$$

$$(219) \text{ Content of cistern} = 10^3 + 2^3 = 1008 \text{ in.}$$

$$\text{Area of base} = (1\frac{1}{3} + 1\frac{2}{3}) \times \frac{1}{3} = \frac{7}{3} \text{ ft.} = 1\frac{1}{3} \text{ in.}$$

$$\therefore \text{Depth} = 1008 \div 1\frac{1}{3} = 27 \text{ in.}$$

$$(220) \text{ Area of walls} = 36 \times 2 \times 9$$

$$\text{,, doors and windows} = 6 \times 3 \times 5$$

$$\therefore \text{Required number of yards} = \frac{(36 \times 2 \times 9 - 6 \times 3 \times 5)}{9 \times 3} \times 4$$

$$= 22\frac{2}{3} = 82\frac{2}{3}$$

$$(221) \quad 278 \text{ lbs.} : 230 \text{ tons} :: \frac{18 \times 17 \times 7}{1728} : \text{required number of cub. ft.}$$

$$\therefore \text{Required number} = \frac{230 \times \overset{10}{\cancel{20}} \times \overset{7}{\cancel{112}} \times \overset{1}{\cancel{18}} \times 17 \times 7}{\underset{139}{\cancel{278}} \times \underset{98}{\cancel{1728}} \underset{6}{\cancel{1728}}} \\ = 2297 \frac{101}{417}$$

$$(222) \quad \text{Required number} = \frac{69 \frac{1}{2} \times 1760 \times 35}{32} = 111104$$

$$(223) \quad \text{See (4), p. 144.}$$

$$(224) \quad \text{See (7), p. 128.}$$

$$(225) \quad \text{See (3), p. 165.}$$

$$(226) \quad \text{See Ex. 1, p. 165.}$$

$$(227) \text{ and } (228). \quad \text{See (28) and (29), p. 180.}$$

$$(229) \quad \begin{array}{r} 15 \\ 105 \\ 945 \\ 990 \\ 110 \end{array} \quad 3\frac{3}{4} \times \frac{945}{990} \times \frac{3}{7} \times 9 = 1s. 1\frac{1}{2}d.$$

$$(230) \quad \text{Quantity filled in a minute} = \frac{1}{30} + \frac{1}{40} - \frac{1}{20} = \frac{1}{120} \\ \therefore \text{the cistern will be filled in 120 min. or 2 hrs.}$$

$$(231) \quad \frac{1}{2} = .5$$

$$\begin{array}{r} 1 \\ \hline 2 \times 3 = .166666\bar{6} \\ 1 \\ \hline 6 \times 4 = .041666\bar{6} \\ 1 \\ \hline 24 \times 5 = .008333\bar{3} \\ 1 \\ \hline 120 \times 6 = .001388\bar{8} \\ 1 \\ \hline 720 \times 7 = .0001984... \\ 1 \\ \hline 5040 \times 8 = .0000248... \\ 1 \\ \hline 40320 \times 9 = .0000027... \\ 1 \\ \hline 362880 \times 10 = .0000002 \\ \hline .7182818 \end{array}$$

In working this question each successive result is easily obtained from the previous one by dividing by 2, 3, 4, &c.: thus the third result = .16666, &c. $\div 4$, the fourth result = .0416, &c. $\div 5$, and so on. In adding up the right hand column we carry 1 for every 9. Had we found the values of the fractions to 8 places we should have found 9 in the 7th place.

(232) $212 - 32 : 80 :: 62 - 32 : \text{Reaumur's mark}$

$$\therefore \text{Reaumur's mark} = \frac{80 \times 30}{180} = 13\frac{1}{3}^{\circ}$$

(233) His gain = $\left(\frac{\pounds 27851 \ 17s. \ 3d.}{78\frac{3}{8}} - \frac{\pounds 27851 \ 17s. \ 3d.}{95\frac{1}{16}} \right) \times \frac{1}{16}$
 $= \pounds 3 \ 18s. \ 5\frac{1}{2}d.$

(234) See (4), p. 144.

(235) See Ex. 1, p. 165.

(236) See (1), p. 132.

(237) See (46), above.

(238) See (8), p. 58.

(239) See (59), p. 131.

(240) $3 \times 8 = 24 \dots 4 \times 9 = 36$

$2 \times 11 = 22 \quad 2 \times 10 = 20$

$2 \times 12 = 24 \quad 4 \times 13 = 52$

$\overline{7) \quad 70} \quad 4 \times 10 = 40$

Average of boys = 10 $\quad 7 \times 10 = 70$

$21) \quad 218$

Average of all = $10\frac{8}{21}$

(241) See Ex., p. 195.

(242) Since $\pounds 34 \ 4s. = 342 \text{ florins}$

$$\text{Required number} = 342 - \frac{577 \cdot 50 \times 10}{26 \cdot 25} = 342 - 220 = 122.$$

(243) and (244). See p. 95.

(245) See (27), p. 82.

(246) Area of floor = $\pounds 6 \ 2s. \ 6d. \div 5s. = 24\frac{1}{2} \text{ sq. yds.}$

$\therefore$ Breadth of room = $\sqrt{\frac{24\frac{1}{2}}{2}} = 3\frac{1}{2} \text{ yds.} = 10\frac{1}{2} \text{ ft.}$; consequently length = $10\frac{1}{2} \times 2 = 21 \text{ feet}$

$\therefore$ Height of room = $\frac{\text{area}}{\text{circuit}} = \frac{(\pounds 2 \ 12s. \ 6d. + 9d.) \times 9}{63} = \frac{70}{7}$
 $= 10 \text{ feet.}$

(247) See (47), p. 111. (248) See (27), p. 180.

(249) $5 : 4 :: 100 : \text{required price}$

$$\therefore \text{Required price} = \frac{4 \times 100}{5} = 80.$$

(250) See p. 132.

(251) $\pounds 96 - \cdot 535 = \pounds 425$

$$\therefore \text{Ans.} = \frac{\pounds 425}{\pounds 4 \cdot 675} = \frac{85}{935} = \frac{1}{11}.$$

(252) See (7), p. 225.

(253) Required number $= (105 + 10) \times 14 \times 60 \times 365$
 $= 115 \times 14 \times 60 \times 365 = 35259000.$

(254) See (46), above.

(255) Number of solid inches $= 1036433728$

$$\therefore \text{Ans.} = \sqrt[3]{1036433728} = 1012 \text{ in.} = 28 \text{ yds. } 4 \text{ in.}$$

(256) $3 : 3\frac{1}{2} :: 72 : \text{required price}$

$$\therefore \text{Required price} = \frac{7 \times 72}{3 \times 2} = 84.$$

(257) Required sum $= \pounds 177 \text{ } 6s. \text{ } 4\frac{1}{2}d. \times \frac{100}{5\frac{1}{4}} = \pounds 3377 \text{ } 10s.$

$$\text{Price of stock} = \frac{\pounds 3377\frac{1}{2} \times 3}{105} = 96\frac{1}{2}.$$

(258) $\text{Ans.} = \frac{2s.}{20\frac{1}{2}} \times 2 - \frac{11s.}{57\frac{1}{2}} = \frac{8s.}{41} - \frac{22s.}{115} = \frac{21s.}{471\frac{1}{2}}d.$

(259) See Ex. 9, p. 152. (260) See (22), p. 100.

(261) See (28), p. 180. (262) See (29), p. 180.

(263) See (48), p. 111.

(264) Required income $= \frac{\pounds 84 \text{ } 7s. \text{ } 6d. \times 240}{2} = \pounds 10125.$

(265) See (3), p. 165. (266) See (32), p. 113.

- (267) See Ex. 7, p. 104. (268) See (231), above.
 (269) $1.875 \times 24 \times 60 \times 60 = 162000''$ *Ans.*
 (270) See (2), p. 144. (271) See Ex. 6, p. 103.
 (272) See Ex., p. 195. (273) See p. 165.
 (274) See (28), p. 180. (275) See (242), p. 202.
 (276) See (59), p. 131. (277) See p. 95.
 (278) See (7), p. 97. (279) See Ex. 5, p. 151.
 (280) See (3), p. 184. (281) See (1), p. 184.
 (282) Required loss = $\frac{\pounds 70 \text{ } 10s. \times 236\frac{1}{2}}{3\frac{1}{2}} = \pounds 4763 \text{ } 15s. \text{ } 8\frac{1}{2}d.$
 (283) See Ex. 4, p. 138. (284) See Ex. 3, p. 155.

LIX. EXAMINATION PAPER, page 206.

See LV., page 182.

LX. EXAMINATION PAPER, page 207.

- (1) See Ex. 1, p. 157. (2) See (6), p. 156.
 (3) See (240), p. 203. (4) See Ex. 2, p. 155.
 (5) See (58), p. 191. (6) See (109), p. 195.
 (7) See Ex. 8, p. 152.
 (8) $\frac{5.1183}{.00705} \times 11.1 \times .29 \times .117 = \frac{511830}{705} \times \frac{100}{9} \times \frac{3}{10} \times \frac{116}{990}$
 $= 283\frac{2}{3}$ *Ans.*

LXI. EXAMINATION PAPER, p. 208.

$$(1) \text{ Required price} = \frac{93 \times 4\frac{1}{2}}{3\frac{1}{4}} = 128\frac{1}{2}$$

$$(2) \text{ Since income from } \pounds 1 \text{ in } 6\frac{1}{2} \text{ per Cents.} = \frac{6\frac{1}{2}}{128\frac{1}{2}}$$

$$\text{and } \quad \quad \quad \pounds 1 \quad \text{,,} \quad 3 \quad \quad \quad = \frac{3}{72\frac{1}{2}}$$

$$\therefore \frac{6\frac{1}{2}}{128\frac{1}{2}} : \frac{3}{72\frac{1}{2}} :: 100$$

$$= \frac{20}{3 \times 100 \times 2 \times 257 \times 7} = \frac{30840}{145 \times 7 \times 13} = \frac{30840}{377} = 81\frac{393}{377}$$

$$\therefore \text{ Loss per cent.} = 100 - 81\frac{393}{377} = 18\frac{74}{377}$$

$$(3) \text{ Quantity of stock} = \frac{\pounds 5000 \times 100}{70\frac{1}{2}} = \pounds 7092\frac{28}{141}$$

$$\text{Required rate} = \frac{100 \times 6}{70\frac{1}{2}} = \pounds 8\frac{24}{141}$$

(4) See Ex. 8, p. 152.

(5) See note, p. 208.

(6) See (1), p. 132.

$$(7) \text{ Gain} = \frac{1000 \times 3}{4} - \frac{1000 \times 19}{25 \cdot 4} = \pounds 750 - \pounds 748\frac{4}{137} = \pounds 1 \text{ } 19s. 4\frac{56}{127}d.$$

$$(8) \quad \text{Ans.} = 920 \text{ roubles}$$

$$1 \text{ r.} = 1 \cdot 2 \text{ francs}$$

$$25 \cdot 15 = \pounds 1$$

$$\therefore \text{ Sum paid to broker} = \frac{920 \times 120}{2515} = \pounds 43\frac{451}{303}$$

$$\text{Again :—Ans.} = 920 \text{ roubles}$$

$$1 \text{ r.} = 1 \cdot 15 \text{ francs}$$

$$25 \cdot 35 \text{ fr.} = \pounds 1$$

$$\text{Sum broker pays} = \frac{920 \times 115}{2535} = \pounds 41\frac{373}{307}$$

$$\therefore \text{ Required gain} = \pounds 43\frac{451}{303} - \pounds 41\frac{373}{307} = \pounds 2 \text{ } 3s. 2\frac{277}{333}d.$$

LXII. EXAMINATION PAPER, page 209.

- (1) The ratio of 1 mile travelled on each is $\frac{18}{405} : \frac{9\frac{1}{4}}{2760}$

$$\frac{2}{45} : \frac{\frac{1}{2760}}{\frac{1}{12}} = 24 : 45 \text{ or } 8 : 15$$

- (2) See (3), p. 165. (3) See Ex. 1, p. 165.

- (4) See (28), p. 180. (5) See (29), p. 180.

- (6) See (7), p. 97. (7) See Ex. 1, p. 157.

- (8) First income = $\frac{\pounds 2000 \times 3}{98\frac{5}{8}} = \pounds 60 \text{ } 16s. \text{ } 8\frac{2}{3}\frac{0}{3}d.$

$$\text{Second „} = \frac{\pounds 2000 \times 4\frac{1}{2}}{93\frac{3}{4}} = \pounds 90 \text{ } 13s. \text{ } 4d.$$

$$\therefore \text{Decrease of income} = \pounds 90 \text{ } 13s. \text{ } 4d. - \pounds 60 \text{ } 16s. \text{ } 8\frac{2}{3}\frac{0}{3}d. \\ = \pounds 29 \text{ } 16s. \text{ } 9\frac{8}{3}\frac{3}{3}d.$$

- (9) See Ex. 2, p. 155.

- (10) Interest on $\pounds 100$ for 52 days at $2\frac{1}{2}d.$ per cent. a day = $130d.$
= $10s. \text{ } 10d.$

$$\therefore \pounds 100 \text{ } 10s. \text{ } 10d. : \pounds 512 \text{ } 15s. \text{ } 3d. :: 10s. \text{ } 10d. \\ : \pounds 2 \text{ } 15s. \text{ } 3d. \text{ } Ans.$$

- (11) $\left. \begin{array}{l} 1 : 4 \\ \frac{1}{3} : 1 \\ 3 : 2 \end{array} \right\} :: 5 \text{ men} : \text{required number}$

$$\therefore \text{Required number} = \frac{4 \times 5 \times 2 \times 5}{3} = 66\frac{2}{3}$$

- (12) Required time = $\frac{10 \times 1760 \times 7 \times 1\frac{2}{3}}{8000 \times 15} = 17\frac{1}{3} \text{ days.}$

- (13) See Ex. 7, p. 187.

- (14) Time by first vessel
- $= 74 \div 9\frac{1}{4} = 8$
- hours

 $\therefore$ it arrives at 4 P.M.

$$\text{Time by second} = \frac{5 \times 8}{8} = 5 \text{ hours}$$

Now 3 hrs. 55' P.M. $-$ 5 hrs. $=$ 10 hrs. 55' A.M.

- (15) Soldiers and navvies do
- $\frac{1}{4}$
- in 1 day

Soldiers and $\frac{1}{2}$ navvies $\frac{1}{7}$ " "

$$\therefore \text{the navvies do in 1 day } (\frac{1}{4} - \frac{1}{7}) \times 2 = \frac{6}{28}$$

$$\text{the soldiers " " } \frac{1}{4} - \frac{6}{28} = \frac{1}{28}$$

$$\text{do. " 4 days } \frac{4}{28} = \frac{1}{7}$$

LXIII. MISCELLANEOUS QUESTIONS, page 210.

- (1) 2)
- 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

$$3) 7, 4, 9, 5, 11, 6$$

$$7 \times 4 \times 3 \times 5 \times 11 \times 2 \times 3 \times 2 = 27720 \text{ L. C. M.}$$

$$(2) \frac{4\frac{1}{2} - 3\frac{1}{3} + 5\frac{1}{12}}{7\frac{1}{2} - 4\frac{1}{3} + 11\frac{1}{2}} - \frac{11\frac{3}{4} - 5\frac{7}{12}}{11\frac{3}{4} + 5\frac{7}{12}} = \frac{54 - 40 + 61}{90 - 52 + 133} - \frac{705 - 328}{705 + 328}$$

$$\frac{75}{177} - \frac{377}{1033} = \frac{4936}{58881}$$

$$\frac{25}{75} - \frac{377}{1033} = \frac{4936}{58881}$$

- (3) See p. 164.

- (4) For first part see p. 88.

$$\frac{1}{\sqrt{2}} = \frac{1 \times \sqrt{2}}{\sqrt{2} \times \sqrt{2}} = \frac{\sqrt{2}}{2} = \frac{1.41421}{2} = .707106...$$

- (5) See (5), p. 182.

- (6) See (26), p. 100.

- (7) The second waggon goes as far when the man is going 40 yards as both have gone when he was going first 20 yards

 $\therefore$ second is 20 yards distant when first is met: hence Ans.

$$(8) \left. \begin{array}{l} £3 \text{ } 17\text{s. } 10\frac{1}{2}\text{d.} : 1 \text{ sov.} \\ 123 : 113 \end{array} \right\} :: 1 \text{ oz.} : \text{required weight}$$

$$\therefore \text{Reqd. weight} = \frac{80 \times 2 \times 113 \times 206}{123 \times \frac{1869}{623}} = 4 \text{ dwts. } 17\frac{6411}{25543} \text{ gra.}$$

$$(9) \sqrt{\frac{13345679}{99999999}} = \sqrt{\frac{1}{81}} = \frac{1}{9} = .1.$$

$$(10) \text{ See (38), p. 130.}$$

$$(11) \text{ See (105), p. 194.}$$

$$(12) \text{ See (39), p. 183.}$$

$$(13) \frac{2}{3} \times \frac{2}{3} = \frac{4}{9} = .44444444. \quad \sqrt{\frac{625}{900}} = \sqrt{\frac{5}{3}} = \frac{5}{3} = 1.66666666.$$

$$(14) \text{ If } £100 \text{ be the cost of a cable :}$$

$$\begin{aligned} \text{First year's net receipts} &= \frac{5}{8} \text{ of } (18 \text{ per cent.} - £600) \\ &= 15 \text{ per cent.} - £500 \end{aligned}$$

$$\begin{aligned} \text{Second year's net receipts} &= 37 - 2(600 + 3 - 100) \\ &= 37 - 6 - £1000 = 31 \text{ per cent.} - £1000 = £14500 \end{aligned}$$

$$\therefore 31 \text{ per cent.} = £15500, \text{ and cost of cable} = \frac{15500 \times 100}{31} = £50,000$$

$$\text{and net receipts} = 500 \times 15 - 500 = £7000.$$

$$(15) £10 \text{ } 10\text{s.} : £100 :: £1 \text{ } 1\text{s.} : \text{required interest}$$

$$\therefore \text{Required interest} = \frac{100 \times 21}{210} = 10.$$

$$(16) \text{ See Ex. 1, p. 125.}$$

$$(17) \text{ and (18). See p. 172.}$$

$$(19) \text{ See Ex. 93, p. 193.}$$

$$(20) \text{ See Ex. 6, p. 139.}$$

$$(21) \text{ Since the increase and decrease per cent. are equal, the cost of the quantities of both wines are equal}$$

$$\therefore \text{galls. of cheaper} : \text{galls. of dearer} :: \text{prime cost of dearer} : \text{prime cost of cheaper} : \text{hence Ans.}$$

(22) $87.45 - 15.9 = 71.55$ increase per cent. of lead

$$\therefore 87.45 : 71.55 :: 216\frac{1}{4} \text{ cwt.} : \text{Ans.}$$

$$\therefore \text{Ans.} = \frac{7155 \times 865}{8745 \times 4} = 176 \text{ tons } 18 \text{ cwt. } 2 \text{ qrs. } 15\frac{3}{11} \text{ lbs.}$$

(23) $\pounds 3 : \pounds 68 \text{ } 3s. \text{ } 6d. :: \pounds 93\frac{1}{2} : \text{required amount}$

$$\therefore \text{Required amount} = \frac{2727}{7 \times 3 \times 240} = \pounds 2124 \text{ } 15s. \text{ } 9d.$$

(24) $\text{Ans.} = \frac{1}{12}$ of 3 oz. 5 dwts. = 5 dwts. 10 grs.

(25) See (16), p. 74.

(26) See Ex. 1, p. 93.

(27) See p. 88.

(28) $\pounds 18 \text{ } 8s. \div \frac{\pounds 4600 \times 1\frac{1}{2}d.}{100} = 4416 \div 69 = 64 \text{ days.}$

(29) See Ex. 1, p. 125.

(30) See p. 164.

(31) Required weight = $\frac{4 \text{ oz.} \times 20}{5.136 \text{ dwts.}} + \frac{1 \text{ lb.} \times 1}{66} = \frac{80 \times 20}{5.136 \times 66}$
 $= 4 \text{ lbs. } 8 \text{ oz. } 12 \text{ dwts. } 19\frac{901}{1177} \text{ grs.}$

(32) See Ex. 1, p. 155.

(33) See (22), p. 100.

(34) and (35). See (59), p. 191.

(36) See Ex. 3, p. 136.

(37) See p. 164.

(38) See p. 77.

(39) See p. 172.

(40) (i) $\text{Ans.} = \frac{3}{100}$ (ii) $\text{Ans.} = \frac{\pounds 3 \text{ } 2s. \text{ } 3d.}{\pounds 100} = \frac{\pounds 2 \text{ } 17s. \text{ } 9d.}{100} = \frac{231}{8000}$

(41) $1 \text{ oz.} \times \frac{5}{8} : 10 \text{ lbs.} \times \frac{525}{500} : \pounds 3 \text{ } 17s. \text{ } 6d. : \text{required price}$

$$\therefore \text{Required price} = \frac{7}{10 \times 12 \times 525 \times 8 \times 31} = \pounds 325 \text{ } 10s.$$

(42) See p. 172.

(43) This is intended to be worked by using a Table of Logarithms.

(44) Area of court-yard = £38 10s. 5d. + 3s. 9d. = 9245 + 45 = $\frac{1849}{9}$ sq. yds.

$\therefore$ Required side = $\sqrt{\frac{1849}{9}} = \frac{43}{3} = 14$ yds. 1 ft.

(45) Since 3 horses = 50 sheep

21 „ and 217 sheep = 567 sheep
and 9 „ and 60 „ = 210 „

$\therefore \left. \begin{array}{l} 567 : 210 \\ 10 : 27 \end{array} \right\} :: £56 \text{ 8s. 4d.} : £56 \text{ 8s. 4d. Ans.}$

(46) *Hand Labour.*

Machine.

$\frac{1}{10}$ of £5000 - 300 = $\frac{£5000}{10} - 300 = 200$	$\frac{1}{8}$ of £4000 - 300 = $\frac{£4000}{8} - 300 = 500$
$\frac{1}{10}$ of £5200 - 300 = $\frac{5200}{10} - 300 = 220$	$\frac{1}{8}$ of £4500 - 300 = $\frac{4500}{8} - 300 = 600$
$\frac{1}{10}$ of £5420 - 300 = $\frac{5420}{10} - 300 = 242$	$\frac{1}{8}$ of £5100 - 300 = $\frac{5100}{8} - 300 = 720$
$\frac{1}{10}$ of £5662 - 300 = $\frac{5662}{10} - 300 = 266.2$	$\frac{1}{8}$ of £5820 - 300 = $\frac{5820}{8} - 300 = 864$
$\frac{1}{10}$ of £5928.2 - 300 = $\frac{5928.2}{10} - 300 = 292.82$	$\frac{1}{8}$ of £6684 - 300 = $\frac{6684}{8} - 300 = 1036.8$
Total from hand labour £6221.02	Total from machine £7720.8

$\therefore £7720.8 - £6221.02 = £1499 \text{ 15s. 7.2d. Ans.}$

(47) This question is worked by algebra.

(48) Income = (£52 10s. - £18 15s.) $\div$ 9d. = 8100 $\div$ 9 = £900
First tax = £18 15s. $\div$ 900 = 4500d. $\div$ 900 = 5d.

(49) Putting 15 per cent. on 28s. and 20 per cent. on 42s. we have

Selling price of wine $32\frac{1}{2}$ } 35s. { $15\frac{3}{4}$
„ „ brandy $50\frac{3}{4}$ } { $2\frac{1}{2}$

$\therefore \text{Ans.} = 15\frac{3}{4} : 2\frac{1}{2} = 77 : 14 = 11 : 2.$

(50) Whole number of sheep=328

Share of each =164

$\therefore A$ got $164 - 144 = 20$ too little

$\therefore £70 \div 20 = £3 \text{ 10s. } Ans.$

(51) Required income = $\frac{£862 \text{ 10s.} \times 240}{230} = £900.$

(52) $\left. \begin{array}{l} 60 : 95 \\ 1 : 25 \end{array} \right\} :: £6000 : \text{amount in francs}$

$\therefore \text{French stock} = \frac{6000 \times 95 \times 25}{60} = 237500 \text{ francs.}$

APPENDIX II. page 223.

—♦—
A.

- (1) Total population of the 3 towns in 1851 = $4402 \cdot 6 \times 3$
= 13207·8

Population of first and second in 1851

$$= \frac{112 \times 4235}{100} + \frac{120 \times 2553}{100} = 4743 \cdot 2 + 3063 \cdot 6 = 7806 \cdot 8$$

Therefore population of third town in 1851

$$= 13207 \cdot 8 - 7806 \cdot 8 = 5401$$

$$\therefore \text{Required decrease} = \frac{(6432 - 5401) \times 100}{6432} = 16 \frac{47}{186}$$

- (2) See Ex. 5, p. 139.

- (3) Total number of days by both working together $108 + 9$
= 12. Therefore the half is done in 6 days, and it requires
the son 6 days more to do his own, and $6 \times 1\frac{1}{2}$ or 9 days to
do as much as his father in 6 days

$$\therefore 6 + 9 = 15 \text{ Ans.}$$

- (4) $\frac{\pounds 12 \text{ } 15s.}{100} : \frac{2\frac{1}{2} \text{ guineas}}{12} \}$ $\therefore 100 : 100 + \text{percentage profit}$

$$\begin{aligned} \therefore \text{Required profit} &= \frac{100 \times \overset{7}{5} \times \cancel{21} \times 100 \times \cancel{20}}{\cancel{12} \times 2 \times \cancel{20} \times \underset{51}{255}} - 100 \\ &= \frac{8750}{51} = 71\frac{29}{51} \end{aligned}$$

- (5) 15 ac. 2 rds. 29 pls. 3 yds. = $75900\frac{1}{4}$ yds.

$$\therefore \text{Required side} = \sqrt{75900\frac{1}{4}} = 275\frac{1}{2} \text{ yards.}$$

- (6) C had no leaves, and consequently he had to pay A and B for what they gave him. Each of the three getting $8+3=2\frac{2}{3}$, A gave $5-2\frac{2}{3}=2\frac{1}{3}$, and B $3-2\frac{2}{3}=\frac{1}{3}$

$\therefore A$ gets $\frac{2\frac{1}{3} \times 8}{2\frac{2}{3}}=7d.$, and B the remainder $1d.$

- (7) $\left. \begin{array}{l} 5\frac{3}{4} : 5 \\ 240 : 230 \end{array} \right\} :: 100 : \text{required price}$

$$\therefore \text{Required price} = \frac{5 \times 230 \times 100 \times 4}{240 \times 23} = 83\frac{1}{3}$$

- (8) Required profit $= 600 \times 1\frac{1}{3}s. - 104 \times 3\frac{1}{3}s. = 900s. - 364s. = \pounds 26 \ 16s.$

- (9) See (4), p. 166.

- (10) First average $= (10\frac{1}{2} + 16\frac{1}{4} + 18\frac{1}{8} + 27\frac{1}{3} + 21\frac{1}{4}) \div 4 = 93\frac{1}{2} \div 4 = 23\frac{3}{8}$

$$\text{Second } ,, = 93\frac{1}{2} \times 2 + 9 = 207\frac{1}{2}$$

- (11) $\pounds 64\frac{3}{4} : \pounds 92\frac{1}{2} :: 70 \text{ guineas} : 100 + \text{required gain}$

$$\therefore \text{Required gain} = \frac{185 \times 70 \times 21 \times 4}{2 \times 20 \times 259} - 100 = 105 - 100 = 5$$

- (12) $\begin{array}{r} 3 \text{ ft. } 5' \ 7'' \\ 2 \quad 7 \end{array}$

$$\begin{array}{r} 6 \ 11 \ 2 \\ 2 \quad 0 \ 3 \ 1''' \end{array}$$

product by 2 ft.

" " 7'

$$\begin{array}{r} 8 \ 11 \ 5 \ 1 \\ 2 \ 11 \ 5 \end{array}$$

" " 2 ft. 7'

$$\begin{array}{r} 17 \ 10 \ 10 \ 2 \\ 8 \quad 2 \ 5 \ 7 \ 11'''' \\ \quad 3 \ 8 \ 9 \ 1 \ 5'''' \end{array}$$

" " 2 ft.

" " 11'

" " 5''

$$\begin{array}{r} 26 \text{ ft. } 5' \ 0'' \ 7''' \ 0'''' \ 5'''' \\ \quad 12 \\ \quad 60 \\ \quad 12 \end{array}$$

26 c. ft. $727\frac{4}{144}$ c. in. Ans.

B.

$$(1) \frac{4}{11} \times \frac{35}{12} \times \frac{22}{7} \times 21s. : 4 \frac{12}{99} \times 16\frac{1}{2}s. :: 35 : 34$$

$$= 70 : \frac{68}{33} \times \frac{1}{2} :: 35 : 34$$

(2) See (24), p. 129.

$$(3) 15s. : 16s. 6d. :: 100 + \frac{7 \times 100}{8}$$

$$\frac{11}{33} \times \frac{37\frac{1}{2}}{2 \times 15} = 206\frac{1}{4} \quad \therefore 206\frac{1}{4} - 100 = 106\frac{1}{4} \text{ Ans.}$$

$$(4) \left. \begin{array}{l} 10 \text{ men} : 12 \text{ men} \\ 1 : 1\frac{1}{2} \\ 3 : 4 \\ 1 : 1\frac{1}{2} \\ 1\frac{1}{2} : 1 \end{array} \right\} :: 25 \text{ days} : \text{required number of days}$$

$$\text{Therefore required days} = \frac{4}{12} \times 7 \times \frac{2}{4} \times 3 \times \frac{5}{25} \times 2 = 70$$

$$(5) \text{Average of each farm} = (£3500 + £11200 + £22750) \div 3 \\ = £12483 \text{ 6s. 8d.}$$

$$\text{Average price per acre} = £37450 \div (125 + 400 + 150) \\ = £55 \text{ 9s. 7}\frac{1}{2}\text{d.}$$

$$(6) 5d. : 12d. :: £5,250,000 : \text{required amount}$$

$$\therefore \text{Required amount} = \frac{£5,250,000 \times 12}{5} = £12,600,000$$

$$(7) \text{ Average loss per day} = \frac{11+8-30+7}{3} = 14\frac{5}{3}$$

$$\therefore \text{ Loss in 150 days} = 14\frac{5}{3}'' + 3 \times \frac{50}{150} = 12' 15\frac{5}{3}''$$

$$(8) \text{ If the breadth be 1, the height is 5, and length 40}$$

$$\therefore \sqrt[3]{\frac{54925}{5 \times 40}} = \sqrt[3]{274.625} = 6.5 \text{ Ans.}$$

$$(9) \frac{1\frac{3}{4}}{3\frac{3}{8}} : \frac{1\frac{1}{4}}{2\frac{1}{3}} : 100 : 100 + \text{required distance}$$

$$\therefore \text{ Required distance} = \frac{5 \times 100 \times \frac{6}{30} \times \frac{4}{7} \times \frac{18}{5}}{\frac{4}{7} \times \frac{73}{7} \times \frac{7}{5}} - 100 = 53\frac{4}{11}$$

$$(10) \text{ In May 31 days} - 6 \text{ hours} = 738 \text{ hours}$$

$$\therefore \text{ in June } 1000 - 738 = 262 \text{ hours} = 10 \text{ days } 22 \text{ hours}$$

$$\therefore \text{ Required time is 10 P.M. on 11th June.}$$

$$(11) 4 \text{ tons } 12 \text{ cwt. } 3 \text{ qrs. } 10 \text{ lbs. } 7 \text{ oz.} = 166375 \text{ oz.}$$

$$\therefore \text{ Required edge} = \sqrt[3]{148375} = 5.5 \text{ feet.}$$

$$(12) \text{ Since the minute hand gains } 55' \text{ in } 60$$

$$\text{Required time is } \frac{60 \times 10}{55} = 10\frac{10}{11} \text{ past 8 o'clock.}$$

C.

$$(1) \text{ Required decimal} = \frac{29454 \times 20 \times 24}{7000} = \frac{14137.92}{7.00} \\ = 2019.70285714$$

$$(2) \text{ See (2), p. 144.}$$

$$(3) 10\frac{9}{99} \times \frac{11}{9990} \times \frac{2}{7} \times 15s. = \frac{111}{11} \times \frac{11}{1110} \times 2 \times 15s. = 3s.$$

$$(4) \frac{4,500,000 \times 8s. \times 106}{100} - 4,500,000 \times 8\frac{1}{2}s. \\ = 38160000 - 37500000 = 660,000s. = \text{£}33000 \text{ Ans.}$$

$$(5) A's \text{ share} = \frac{1}{3} \text{ of } \text{£}658 \text{ } 17s. = \text{£}131 \text{ } 15s. \text{ } 4\frac{2}{3}d. \\ \text{The other shares can be found in the same way.}$$

$$(6) \text{ See (47), p. 111.} \quad (7) \text{ See solution of (7), p. 58.}$$

$$(8) \quad 95 : 103\frac{3}{4} :: \text{£}116 \text{ } 17s. : \text{required price} \\ \therefore \text{Required price} = \frac{\text{£}116 \text{ } 17s. \times 415}{95 \times 4} = \text{£}127 \text{ } 12s. \text{ } 3d.$$

$$(9) \frac{3123 \times 7 \cdot 4}{100} + \frac{1017 \times 9 \cdot 3}{100} = 231 \cdot 102 + 94 \cdot 581 = 325 \cdot 683 \\ \therefore \text{Required percentage} = \frac{325 \cdot 683 \times 100}{5267} = 6 \cdot 183...$$

$$(10) \text{ Gross income} = \frac{\text{£}1728 \times 40}{39} = \text{£}1772 \text{ } 6s. \text{ } 1\frac{1}{3}d.$$

$$(11) \text{ Force of stream} = \frac{1}{40} \text{ in a minute} \\ \text{Force of rowing} = \frac{1}{70} + \frac{1}{40} \text{ " " } \\ \therefore \text{Ans.} = \frac{1}{70} + \frac{1}{40} : \frac{1}{40} = 11 : 7$$

$$(12) \text{ It is evident the person will see the other as long as the one} \\ \text{train which gains 22 miles an hour is gaining 150 yards,} \\ \text{or the length of the shorter, on the other}$$

$$\therefore \text{Required time} = \frac{150 \times 60'}{22 \times 1760} = 13\frac{222}{143} \text{ secs.}$$

Some take a different view of this question.

D, page 226.

$$(1) \sqrt{459684} = 678$$

$$\text{and } \sqrt{29 \cdot 16 \times 13 \cdot 69} = 19 \text{ yards } 2 \cdot 94 \text{ feet.}$$

$$(2) \text{ See (27), p. 180.}$$

$$(3) \text{ First income} = \frac{\pounds 18550 \times 3\frac{1}{2}}{92\frac{3}{4}} = \pounds 700$$

$$\begin{aligned} \text{Second „} &= \frac{\pounds 18550 \times 4}{5 \times 96} + \frac{\pounds 18550 \times 4 \times 3}{90 \times 5} \\ &= \pounds 154 \text{ } 11s. \text{ } 8d. + \pounds 494 \text{ } 13s. \text{ } 4d. \end{aligned}$$

$$\text{Therefore alteration} = \pounds 700 - \pounds 649 \text{ } 5s. = \pounds 50 \text{ } 15s.$$

$$(4) \quad 10 \text{ lines} : 126 \cdot 9667 \text{ lines} :: \frac{8}{9} \text{ ft.} : \text{required length}$$

$$\therefore \text{Required length} = \frac{126 \cdot 9667 \times 8}{10 \times 9} = 11 \cdot 285928 \text{ feet.}$$

$$(5) \text{ and } (6). \text{ See (12), p. 223.}$$

$$(7) \quad 5s. \text{ } 2d. : 100 :: 4d. : \text{required profit}$$

$$\therefore \text{Required profit} = \frac{100 \times 4}{62} = 6\frac{1}{3}\frac{1}{4}$$

$$(8) \text{ See Ex. 2, p. 155.}$$

$$\begin{aligned} (9) \text{ Required weight} &= \frac{534}{\pounds 3 \text{ } 17s. \text{ } 10\frac{1}{2}d.} \times \frac{5}{8} = \frac{534 \times 480 \times 5}{1869 \times 6} \\ &= 114\frac{2}{3} \text{ oz.} \end{aligned}$$

$$(10) \quad \frac{\pounds 358 \cdot 3125 \times 2 \cdot 75 \times 2 \cdot 5}{100} = \pounds 24 \text{ } 6\text{ } 3c. \text{ } 3 \cdot 984375 \text{ } m.$$

$$(11) \quad 37 \cdot 084 \times 13 \cdot 57 = 503 \cdot 22988 = \pounds 503 \text{ } 4s. \text{ } 7 \cdot 1712d. \text{ } \text{Ans.}$$

$$(12) \text{ Number lost} = \frac{729 \times 16}{13\frac{1}{2}} = 864$$

$$\text{Saved by rocket and mortar} = \frac{729 \times 8}{13\frac{1}{2}} = 432, \text{ and so on.}$$

E, page 227.

$$(1) \text{ Required number} = \frac{\text{£}3296 \text{ } 13s. \text{ } 5\frac{1}{4}d. \times 70}{\text{£}1025} = 225$$

(2) See p. 97.

(3) See (28) and (29), p. 180.

$$(4) \text{ Present value} = \frac{100 \times \text{£}10}{110} = \text{£}9\frac{1}{11}$$

$$\text{Proof } \frac{9\frac{1}{11} \times 2 \times 5}{100} = \text{£}1\frac{0}{11}$$

$$\therefore \text{£}9\frac{1}{11} + \text{£}1\frac{0}{11} = \text{£}10.$$

$$(5) \text{ Square root} = (1+9) \times \frac{2}{3} = 45.$$

$$(6) \text{ Required price} = \frac{\text{£}25 \text{ } 19s. \text{ } 10d.}{7 \text{ cwt. } 2 \text{ qrs. } 15 \text{ lbs.}} \times \frac{115}{100} = \frac{6238d. \times 115}{855 \times 100} \\ = 8\frac{3337}{550}d.$$

(7) The 1st of January in 1867 was Tuesday; and since in every year there is a change of a day, and in every leap year of two days, we have number of changes = $1880 - 1867 + 8 = 16$, and $16 \div 7 = 2\frac{2}{7}$, making two weeks of changes, and two days. $\therefore$ Ans. Thursday. The other days can be found in the same manner.

$$(8) \text{ Required number} = \frac{25000 \times 16 \times 2}{\frac{7680 \times 3 \times 12 \text{ in.}}{6 \times 30 \text{ in.}}} = 800000 \quad \text{Ans.}$$

(9) See Ex. 8, p. 152.

(10) See (7), p. 128.

-) Multiplying the second by 3 we have:

$$\begin{array}{rcl}
 15 \text{ turkeys} + 9 \text{ fowls} & = & \text{£}15 \text{ (from)} \\
 2 \quad \text{,,} \quad + 9 \quad \text{,,} & = & \text{£}3 \text{ (take)} \\
 \hline
 \therefore 13 \text{ turkeys} & = & \text{£}12 \\
 \text{and 1 turkey} & = & \text{£}1\frac{2}{3} \\
 \therefore 9 \text{ fowls} & = & \text{£}3 - 1\frac{2}{3} = 1\frac{4}{3} \\
 \text{and 1 fowl} & = & \text{£}1\frac{2}{3} + 9 = \text{£}3\frac{5}{3}
 \end{array}$$

-) $\text{£}2 \text{ } 5s. : \text{£}11 \text{ } 5s. :: 3 \text{ feet} : \text{required breadth}$
 $\therefore \text{Required breadth} = \frac{\text{£}225 \times 3}{45} = 15 \text{ feet.}$

F.

-) See Ex. 3, p. 155. (2) See (93), p. 193.
) The square root of three times the square of the edge will give the diagonal
 $\text{Edge} = \sqrt[3]{37 \text{ c. ft. } 64 \text{ in.}} = \sqrt[3]{64000} = 40 \text{ in.}$
 $\therefore \text{Diagonal} = \sqrt{3 \times 40^2} = \sqrt{4800} = 69.282 \text{ in.}$
) Amount of $\text{£}123 \text{ } 15s.$ in 2 years at 5 p. c. = $\text{£}136 \text{ } 2s. \text{ } 6d.$
 Present worth of it due 2 yrs. hence ,, = $112 \text{ } 10 \text{ } 0$
 $\therefore \text{Required difference} = \text{£}23 \text{ } 2s. \text{ } 6d.$
) Since $C = D + 40$, and $D = B + 60$
 $\therefore C = B + 100 = A.$
) See (240), p. 203. (7) See (11), p. 234.

$$\begin{array}{r}
 2 \qquad \qquad \qquad 8599 \qquad \qquad \qquad 63 \\
 962 \qquad \qquad \qquad 318163 \qquad \qquad \qquad 6993 \qquad 16 \\
 2886 \qquad \qquad \qquad 4136119 \qquad \qquad \qquad 76973 \qquad 64 \\
 31746 \qquad \qquad \qquad 74450142 \qquad \qquad \qquad 999999 \qquad 128 \\
 999999 \times 8 \qquad \qquad \qquad 818951562 \qquad \qquad \qquad 158730 \qquad 63 \times 92599 \times 63 \\
 999999 \qquad \qquad \qquad 9999999000 \qquad \qquad \qquad 12210 \qquad 10500 \times 10 \\
 90909 \qquad \qquad \qquad 90909000 \qquad \qquad \qquad 1110 \qquad 2625 \qquad 5 \\
 30303 \qquad \qquad \qquad 5050500 \qquad \qquad \qquad 10500 \\
 63 \qquad \qquad \qquad 388500 \qquad \qquad \qquad 10 \\
 \qquad \qquad \qquad 10500
 \end{array}$$

$$\begin{array}{r}
 1481584 \\
 = \frac{13125}{13125} = 112.8825904761. \text{ Ans.}
 \end{array}$$

(9) £1 in the 3 per Cents. will give $\frac{3}{87\frac{1}{2}} = \frac{12}{350}$

£1 " 5 " " " $\frac{5}{131\frac{1}{4}} = \frac{12}{315}$

∴ since $\frac{12}{315}$ is greater than $\frac{12}{350}$, the 5 per Cents. are the better investment.

Difference in £1 invested $= \frac{12}{315} - \frac{12}{350} = \frac{120 - 108}{3150} = \frac{2}{3150}$

Now $\frac{12}{3150} : 50 :: 1 : \text{required sum}$

∴ Required sum $= \frac{50 \times 3150}{12} = £13125.$

(10) A and B do $\frac{5}{18}$ in 1 day

A does $\frac{1}{8}$ "

∴ $\frac{5}{18} - \frac{1}{8} = \frac{3}{18}$ what B can do in 1 day

∴ Required time $= \frac{18}{3} = 6$ days.

(11) They are at 6 o'clock 30' apart; and when the hour hand gains 7' on the minute hand they will be 23' apart

∴ 11 : 12 :: 7 : 7 $\frac{1}{11}$ ' past 6

They will also be 23' apart when the minute hand gains 30 + 23 = 53' on the hour hand

∴ 11 : 12 :: 53 : 57 $\frac{2}{11}$ ' past 6.

(12) Of the 3 hours the train was late it lost 2 by slow travelling; and going $\frac{2}{3}$ its speed travels 30 miles when it should travel 50, and goes the 20 miles in 1 hr. 20' at $\frac{2}{3}$ speed

∴ its reduced rate is $1\frac{1}{3} : 1 :: 20 \text{ miles} : 15 \text{ miles}$, which is $= \frac{2}{3}$ its speed

∴ its full speed = 25 miles

Distance travelled to lose 2 hours = $1\frac{1}{3} : 2 :: 50 : 75$ miles, the distance gone after the accident

∴ Length of line = 75 + 25 = 100 miles.

G.

(1) See (10), p. 225.

(2) Average selling price = $\frac{95\frac{7}{8} + 92\frac{5}{8}}{2} = 94\frac{1}{4}$ the buying price $\therefore$ he neither loses nor gains.

(3) See (7) and (8), p. 58.

(4) First percentage gain on 100 = 30

Second " " $130 = \frac{130 \times 50}{100} = 65$ $\therefore$ Required gain = $65 + 30 = 95$.(5) $\begin{matrix} 100 \text{ stock} & : & 135 \text{ stock} \\ 3 & : & 4\frac{1}{2} \end{matrix} \left. \vphantom{\begin{matrix} 100 \\ 3 \end{matrix}} \right\} \therefore \pounds 97\frac{1}{8} : \text{required value}$ $\therefore$ Required value = $\frac{135 \times 9 \times 777}{100 \times 2 \times 8 \times 3} = \pounds 196 \text{ } 13s. \text{ } 6\frac{3}{4}d.$

(6) See Ex. 7, p. 152.

(7) $\begin{matrix} 1\frac{8}{10} = 18 \text{ days taken by first} \\ 1\frac{8}{8} = 30 \text{ " " second} \\ 1\frac{8}{4} = 45 \text{ " " third} \end{matrix}$ $\therefore$ Required time = L.C.M. of 18, 30, and 45 = 90First travels $90 \times 10 = 900$ milesSecond " $90 \times 6 = 540$ "Third " $90 \times 4 = 360$ "

(8) Since 5, 6, and 7 are in the same ratio as 50, 60, and 70

$$5 \times 50 = 250$$

$$6 \times 60 = 360$$

$$7 \times 70 = 490$$

$$\text{Cost of 18} \quad = 1100$$

 $\therefore 100 : 120 :: 1\frac{1}{8} : \text{required price}$

$$\therefore \text{Required price} = \frac{1100 \times 120}{100 \times 1\frac{1}{8}} = 73\frac{1}{3}s.$$

(9) See (84), p. 193.

$$(10) \sqrt{.047619 \div .06285714} = \sqrt{(\frac{1}{21} \times \frac{700}{44})} = \sqrt{\frac{25}{22}} = \sqrt{.75} \\ = .87038 \dots \text{Ans.}$$

(11) See (17), p. 182.

(12) See Ex. 5, p. 186.

H.

(1) See (73), p. 192.

(2) See (28), p. 180.

(3) 6 sq. ft. 6 in. = 870 sq. in.; $\therefore 870 \times 640 = 556800$ acres

(4) See (4), p. 166.

(5) See Ex. 7, p. 152.

(6) A walks 10 miles in $2\frac{2}{3}$ hours

B ,, $4 \times 2\frac{2}{3} = 10\frac{2}{3}$ miles in the same time

$\therefore 50 - 10 - 10\frac{2}{3} = 29\frac{1}{3}$ still to be travelled

$$\therefore 5 + 4 : 5 :: 29\frac{1}{3} : \text{part of } 29\frac{1}{3} \text{ travelled by A} = \frac{88 \times 5}{27} \\ = 16\frac{8}{9}$$

$\therefore$ Distance from London = $16\frac{8}{9} + 10 = 26\frac{8}{9}$ miles.

(7) See (7), p. 224.

(8) See Ex. 1, p. 165.

$$(9) \quad 1.428571 \times 1\frac{\overset{7}{63}}{\underset{11}{99}} = 1\frac{3}{7} \times 1\frac{7}{11} = \frac{10}{7} \times \frac{11}{11} = 2\frac{2}{7} \text{ product}$$

$$1\frac{3}{7} \div 1\frac{7}{11} = \frac{\overset{5}{10}}{7} \times \frac{11}{\underset{9}{18}} = \frac{55}{63} \text{ quotient}$$

$$\therefore 2\frac{2}{7} - \frac{55}{63} = 1\frac{46}{63} = 1.46 \text{ difference.}$$

$$(10) \quad \left. \begin{array}{r} 20 \times 87\frac{1}{2} = 175 \\ 40 \times 95 = 380 \\ 50 \times 85 = 425 \\ \hline 11 \quad 11 \overline{) 980} \end{array} \right\} \text{average rate} = \frac{100 \times 3 \times 11}{980} = 3\frac{1}{2}$$

Average price = $89\frac{1}{11}$

$$\therefore 89\frac{1}{11} : 100 : 3 : \text{average rate.}$$

$$(11) \text{ Required number} = 29\frac{1}{2} \times 17\frac{18}{90} = \frac{266 \times 86 \times 9}{9 \times 5 \times 3 \times 22}$$

$$= 69\cdot321 \text{ yards.}$$

$$(12) \quad \frac{4\frac{1}{2} + 6\frac{1}{2}}{\frac{1}{2} + \frac{3}{2}} + \frac{7\frac{1}{2} \times 3\frac{3}{2}}{\frac{5}{2} - \frac{3}{2}} + 6\frac{1}{2}$$

$$= \frac{37}{9} \times \frac{2}{37} \times \frac{23}{68} + \frac{41}{11} \times \frac{21}{128} \times \frac{63}{8} \times \frac{5}{378} = \frac{23}{34} + \frac{105}{4} = 26\frac{3}{4}$$

I., page 231.

(1) See Ex. 2, p. 157.

(2) If the charge of first be 1

$\therefore$ „ second is $1\frac{1}{2}$

Now gain of second over first in 15 shots = $1\frac{1}{2} \times 7 - 1 \times 8$
 $= 9\frac{1}{2} - 8 = 1\frac{1}{2}$

$\therefore 1\frac{1}{2} : 36 :: 15 \text{ shots} : \text{required number} - 36$

$\therefore$ Required number = $\frac{36 \times 3 \times 15}{4} + 36 = 441.$

(3) See (253), p. 204.

$$(4) \quad £5\frac{1}{4} : £126 \text{ } 13s. \text{ } 1\frac{1}{2}d. :: 100 : \text{sum invested}$$

$$\therefore \text{sum invested} = \frac{£126 \text{ } 13s. \text{ } 1\frac{1}{2}d. \times 100}{5\frac{1}{4}} = £2412 \text{ } 10s.$$

Now £75 : £3 :: £2412 10s. : price of 3 per Cents.

$$\therefore \text{Price of 3 per Cents.} = \frac{£2412 \text{ } 10s. \times 3}{75} = 96\frac{1}{2}$$

$$(5) \text{ Required ratio} = \frac{\begin{array}{r} 43 \\ 129 \\ 387 \\ 1935 \end{array} \times \begin{array}{r} 11 \\ 77 \\ 22 \\ 1307 \end{array} \times \begin{array}{r} 32 \\ 64 \\ 16 \\ 100 \end{array} \times \begin{array}{r} 1 \\ 31 \\ 6 \\ 7 \end{array}}{\begin{array}{r} 1015 \times 1307 \times 114 \times 65 \\ 203 \quad 651 \quad 6 \\ 2100 \quad 7 \\ 700 \end{array}}$$

$$= 43 \times 11 \times 32 : 203 \times 7 \times 65 = 15136 : 92365$$

$$(6) \quad 115 : 15 :: £75000 : \text{contractor's gain}$$

$$\therefore \text{Required gain} = \frac{75000 \times 15}{115} = £9782 \text{ } 12s. \text{ } 2\frac{2}{3}d.$$

Now since 20 per cent. on 1 = 10 per cent. on 2, the alteration in price does not affect his gain.

$$(7) \quad 4\frac{3}{8} : 4 :: 100 : \text{required price}$$

$$\therefore \text{Required price} = \frac{4 \times 100 \times 8}{35} = 91\frac{3}{7}$$

$$(8) \quad \sqrt[3]{42.875} = 3.5 \text{ the edge of the box}$$

$$\therefore \text{Required cost} = \frac{3.5 \times 3.5 \times 6 \times 1\frac{1}{3}s.}{9 \times 20} = 10s. \text{ } 10\frac{2}{3}d.$$

$$(9) \text{ Loss on 360 shares} = (2\frac{1}{8} - 2\frac{3}{8}) \times 360 = £157 \text{ } 10s. \text{ } 0d.$$

$$\text{Brokerage} = (2\frac{1}{8} + 2\frac{9}{16}) \times 360 \times \frac{1}{16} = \begin{array}{ccc} 9 & 6 & 9 \end{array}$$

$$\therefore \text{His total loss} = £166 \text{ } 16s. \text{ } 9d.$$

$$(10) \text{ See Ex. 1, p. 118.}$$

$$(11) \quad \therefore \text{Required increase} = \frac{24000 \times 6}{28000} = 5\frac{1}{7}$$

$$(12) \text{ See Ex. 9, p. 152.}$$

J., page 232.

$$(1) \text{ Gross income} = \frac{\pounds 1250 \times 100}{96} = \pounds 1302 \text{ 1s. 8d.}$$

(2) See Ex. 1, p. 157.

$$(3) \text{ Required amount} = \frac{\pounds 76 \text{ 3s. } 10\frac{1}{2}\text{d.} \times 100}{365\text{d.}} = \pounds 5010$$

(4) See (257), p. 204. (5) See (8), p. 182.

(6) When simplified the quantities are $3\frac{2}{3}$, $3\frac{2}{3}$, $3\frac{2}{3}$, $3\frac{1}{2}\frac{21}{10}$, $3\frac{1}{3}\frac{23}{10}$, and the fractions become

$$\frac{48000, 20250, 56160, 34848, 15440}{72000}$$

$\therefore 1\cdot8$ of $2\cdot1$, $3\frac{2}{3}$, &c. *Ans.*

(7) See (1), p. 224.

$$(8) (\pounds 203 - \pounds 118) \times 5 = \cdot 425 = 8\text{s. 6d.}$$

$$(9) \quad \begin{aligned} \sqrt[3]{3 \times 6} &= 8\cdot653 \dots \text{one side} \\ \sqrt[3]{3 \times 5} &= 7\cdot211 \dots \text{the second} \\ \sqrt[3]{3 \times 4} &= 5\cdot76 \dots \text{the third.} \end{aligned}$$

(10) See (1), p. 58.

$$(11) \text{ Required income} = \frac{\pounds 4700 \times 3}{95\frac{3}{8}} = \pounds 147 \text{ 16s. } 8\frac{7}{8}\frac{2}{3}\text{d.}$$

$$\text{Required rate} = \frac{3 \times 100}{95\frac{3}{8}} = \pounds 31\frac{11}{13}$$

(12) Interest on $\pounds 2300000$ at $4\frac{1}{4}$ per cent. per annum = $\pounds 97750$

$$\text{Net receipts} = \frac{\pounds 635000 \times 55}{100} = \pounds 349250$$

$$\text{Sum for shareholders} = \pounds 349250 - \pounds 97750 - \pounds 110000 = \pounds 240500$$

$$\therefore \text{Required dividend} = \frac{\pounds 240500 \times 100}{3700000} = 6\frac{1}{2}$$

K., page 233.

- (1) See Ex. 1, p. 132. (2) See Ex. 1, p. 143.

$$(3) \text{ Number of cubic feet left} = 12 \times 8\frac{5}{8} \times 6\frac{1}{2} - \frac{4000 \times 277 \cdot 279}{1728}$$

$$= 689 - 641\frac{367}{432} = 47\frac{65}{432}$$

$$\text{Now } 47\frac{65}{432} \times £2\frac{19}{8} = £103 \text{ } 12s. \text{ } 7\frac{5}{8}\frac{1}{4}d. \text{ Ans.}$$

- (4) It is evident the number of lambs does not affect the mean price

$$\therefore \left. \begin{array}{l} 100s. \\ 5s. \end{array} \right\} 20s. \left\{ \begin{array}{l} 15 \text{ goats} \\ 80 \text{ calves} \\ 5 \text{ lambs} \end{array} \right\} \begin{array}{l} \text{or } 3, 16, \text{ and } 81 \\ \text{or } 6, 32, \text{ and } 62 \end{array}$$

These three answers will suit the conditions of the question.

- (5) See Ex. 2, p. 155.

$$(6) \text{ Required weight} = \frac{37}{16} \text{ of } \frac{1}{8} \text{ of a pound} = \frac{37 \times 12 \times 20 \text{ dwts.}}{40 \times 66}$$

$$= 3 \text{ dwts. } 8\frac{1}{11} \text{ grs.}$$

- (7) See (4), p. 225.

$$(8) \text{ Number of sovereigns} = £280 \div 1\frac{1}{8} = 240$$

$$\therefore \text{ Number of shillings} = 720, \text{ and pence } 960.$$

$$(9) \text{ Content of wood} = (16 \times 12 \times 8) - (15 \times 11 \times 7)$$

$$= 1536 - 1155 = 381 \text{ in.} = 3 \text{ lbs.}$$

Required ratio is the weight of 1 in. of wood : 1 in. sand

$$= \frac{105}{381} : \frac{2}{1155} = 3 \times \frac{105}{1155} : \frac{2}{381} = 105 : 254$$

$$(10) \text{ Price of } 12 \text{ cwt. } 3 \text{ qrs. } 7 \text{ lbs.} \times 13 \text{ at } £2 \text{ } 16s. \text{ per cwt.}$$

$$= £345 \text{ } 12s. \text{ } 4\frac{1}{2}d.$$

$$\text{Interest on } £345 \text{ } 12s. \text{ } 4\frac{1}{2}d. \text{ for } 8 \text{ months at } 5 \text{ per cent.}$$

$$= £11 \text{ } 10s. \text{ } 4\frac{1}{4}d.$$

$$\therefore \text{ Required sum} = £420 - £357 \text{ } 2s. \text{ } 9\frac{1}{4}d. = £62 \text{ } 17s. \text{ } 2\frac{1}{4}d.$$

$$(11) \text{ Amount of stock} = \frac{\pounds 1250 \times 100}{78\frac{1}{8}} = \pounds 1600$$

$$\text{Rate of interest} = \frac{100 \times 5}{78\frac{1}{8}} = \pounds 6\frac{2}{3}$$

(12) See (12), p. 232.

L., page 234.

(1) See Ex. 1, p. 125.

$$(2) \text{ Earnings of first class} = \frac{270 \times 4}{27} \times 40 \times 2d. = 13 \text{ } ^{\text{£}} \text{ } ^{\text{s.}} \text{ } ^{\text{d.}} \begin{matrix} 6 \\ 8 \end{matrix}$$

$$\text{,, ,, second} = \frac{270 \times 7}{27} \times 35 \times 1\frac{1}{2}d. = 15 \text{ } ^{\text{£}} \text{ } ^{\text{s.}} \text{ } ^{\text{d.}} \begin{matrix} 6 \\ 3 \end{matrix}$$

$$\text{,, ,, third} = \frac{279 \times 16}{27} \times 25 \times 1d. = 16 \text{ } ^{\text{£}} \text{ } ^{\text{s.}} \text{ } ^{\text{d.}} \begin{matrix} 13 \\ 4 \end{matrix}$$

$$\therefore \text{ Total earning } \pounds 45 \text{ } ^{\text{s.}} \text{ } ^{\text{d.}} \begin{matrix} 6 \\ 3 \end{matrix}$$

$$(3) \text{ Triangle } ABm = 182 \times 60 = 10920 \text{ links}$$

$$\text{,, } CDn = 250 \times 180 = 45000$$

$$\text{,, } DEy = 190 \times 85 = 16150$$

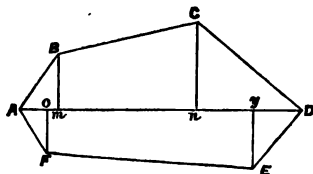
$$\text{,, } AFo = 68 \times 95 = 6460$$

$$\text{Trapezium } BCnm = 440 \times 216 = 95040$$

$$\text{,, } EFoy = 655 \times 163 = 106765$$

$$\text{Total area} = 280335$$

$$\therefore 280335 \text{ links} \div 100000 = 2 \text{ ac. } 3 \text{ rds. } 8.536 \text{ pls.}$$



- (4) Take £27, salary of first year

1st year's salary	£27,	savings	£18
2nd	"	"	36
3rd	"	"	48
4th	"	"	64
			42 $\frac{2}{3}$

Total savings £116 $\frac{2}{3}$

$$\therefore 116\frac{2}{3} : 259\frac{7}{27} :: £27 : \text{required salary}$$

$$\therefore \text{Required salary} = \frac{27 \times 7000 \times 3}{27 \times 350} = £60.$$

- (5) See (21), p. 188.

$$(6) \text{ Required price} = (14 \times 130 + 57 \times 14 + 29 \times 36) \\ \div 20 \times 3s. 9d. = £34 \text{ } 6s. 7\frac{1}{2}d.$$

$$(7) \sqrt[3]{320 \cdot 013504} = 6 \cdot 84 \text{ chains} = 684 \text{ links. } Ans.$$

$$(8) \text{ Gain on } £1000 = 10 \times 3\frac{1}{2} = £35; \text{ but the net gain is only } £6 \text{ } 5s.$$

$$\therefore \text{ Loss must be } £35 - 6\frac{1}{2} = 28\frac{1}{2}$$

$$\text{Loss on } £100 = 90 - 84\frac{1}{2} = 5\frac{1}{2}$$

$$\therefore \text{ Stock sold at a loss} = \frac{5\frac{1}{2}}{28\frac{1}{2}} \times 100 = £500$$

$$\therefore \text{ Required sum} = \frac{1500 \times 90}{100} = £1350$$

$$\text{First income} = \frac{1500 \times 8}{100} = £45$$

$$\text{Second } ,, = \frac{(1350 + 6\frac{1}{2}) \times 4}{100} = £54 \text{ } 5s.$$

$$\therefore \text{ Required difference} = £54 \text{ } 5s. - £45 = £9 \text{ } 5s.$$

- (9) If the first's capital be 1, that of the second is 2, and the third $\frac{3}{2} = 1\frac{1}{2}$; then divide £5000 into parts proportional to 1, 2, $1\frac{1}{2}$, and $4\frac{1}{2}$.

- (10) See (15), p. 59.

- (11) The men walk $\frac{1}{10}$, $\frac{1}{15}$, and $\frac{1}{20}$, respectively, in a minute; the first gains on the second $\frac{1}{10} - \frac{1}{15} = \frac{1}{30}$, and on the third $\frac{1}{10} - \frac{1}{20} = \frac{1}{20}$ in a minute

$\therefore$ the first and third will be together in $11\frac{1}{2}$ minutes, and the first and second in $22\frac{1}{2}$ minutes, the shortest time the three will be together.

- (12) The first man goes in $10'' = \frac{4 \times 1760 \times 10}{60 \times 60} = 19\frac{1}{3}$ yards

$$\therefore \text{Train } ,, \quad 10'' = 88 + 19\frac{1}{3} = 107\frac{2}{3} \text{ yards} \\ = 22 \text{ miles an hour}$$

$$\text{Train } ,, \quad 9'' = \frac{9}{10} \text{ of } 107\frac{2}{3} = 96\frac{2}{3} \text{ yards}$$

$$\therefore \text{Second man } ,, \quad 9'' = 96\frac{2}{3} - 88 = 8\frac{2}{3} \text{ yards} = 2 \text{ miles} \\ \text{an hour}$$

In $20'$ the train is $\frac{2}{3} - \frac{1}{3} = \frac{1}{3}$ miles before the first man

$\therefore$ Since the first man gains 2 miles an hour on the second, he will overtake him in 3 hours

$\therefore$ the train will be $22 \times 3 - 3 \times 2 = 60$ miles distant.

M., page 235.

- (1) Required number of lines $= 41.06328 \div .0438 = 937$, leaving a remainder .02268 in., which is the length of the remaining line.

- (2) Average decrease $= (\pounds 369 \text{ } 18s. \text{ } 10d. - \pounds 360 \text{ } 1s. \text{ } 1d.) \div 21$
 $= 9s. \text{ } 5d.$

$$\therefore \text{Required average} = \pounds 374 \text{ } 9s. \text{ } 8d. - 9s. \text{ } 5d. = \pounds 374 \text{ } 0s. \text{ } 3d.$$

- (3) Breadth $= \sqrt{\frac{6 \text{ ac. } 900 \text{ yds.}}{3}} = \sqrt{99.899} \dots$ the breadth.

- (4) Loss per cent. $= (\pounds 1 - 6s. \text{ } 10\frac{1}{2}d.) \times 100 = 65\frac{1}{2}\%$.

- (5) Required gain $= 15 + \text{his gain per cent. in selling}$
 $= 15 + \frac{115 \times 15}{100} = 32\frac{1}{4}$

(6) See (3), p. 184.

(7) $270000 : 210000 :: £54 : \text{required price}$

$$\therefore \text{Required price} = \frac{210000 \times 54}{270000} = £42, \text{ that is, 8 discount.}$$

(8) Required price $= \frac{3\frac{1}{4} \times 100}{5} = £65$

$90 : 72 :: 65 \text{ first income} : \text{second income}$

$$\therefore \text{Second income} = \frac{72 \times 65}{90} = £52$$

$$\therefore 65 - 52 = £13 \text{ decrease.}$$

(9) If A takes 6, B will take $4\frac{1}{2}$; $\therefore$ the number 1155 is to be divided in proportion to 6, $4\frac{1}{2}$, and 7.

(10) Since $36000 = \frac{3}{4}$ of remainder, $12000 = \frac{1}{4}$

$$\therefore 48000 + (8000 - 6000) = \frac{5}{8} \text{ of the army} = 50000$$

$$\therefore \text{Whole army} = 50000 + 10000 = 60000.$$

(11) $4 \cdot 285714 \times 4 \cdot 09 = 4\frac{2}{7} \times 4\frac{1}{11} = \frac{3^9}{7} \times \frac{4^2}{11} = 17 \cdot 532467$

$$\text{Again: } \frac{30}{7} + \frac{45}{11} = \frac{30}{7} \times \frac{11}{\frac{2}{3}} = \frac{22}{21} = 1 \cdot 047619.$$

(12) The first will be $\frac{3}{4}$ hour + $\frac{12}{5\frac{1}{4}} = 2\frac{7}{8}$ hours in reaching B

The second will go $2\frac{7}{8} \times 3\frac{1}{2} = 10\frac{5}{8}$ miles in the same time

$$\therefore \text{Distance still to be travelled} = 15 - 10\frac{5}{8} = 4\frac{3}{8} \text{ miles.}$$

N., page 236.

(1) With the wind he goes 10 miles an hour

$$\text{Against it } \frac{6 \times 60}{50} = 7\frac{1}{5} \quad \text{,,} \quad \text{,,}$$

$$\therefore \text{Twice force of the wind} = 10 - 7\frac{1}{5} = 2\frac{4}{5}$$

$$\therefore \text{Force } \text{,,} \quad \text{,,} \quad = 1\frac{2}{5} \text{ miles an hour}$$

In 6 miles the wind brings him $1\frac{2}{3} \times 36 + 60 = 3\frac{1}{3}$ of a mile

In 50' it resists him $1\frac{2}{3} \times 50 + 60 = 1\frac{1}{3}$ miles

Consequently the wind retards him $1\frac{1}{3} - 3\frac{1}{3} = \frac{1}{3}$ of a mile
 $= 1167\frac{7}{8}$ yards in the whole journey.

- (2) £202 4s. - £2 4s. = £200 present worth

From the 5th of July to the 16th of September = 73 days

£200 : £100 } :: £2 4s. : required rate
 73 days : 365 days }

$$\therefore \text{Required rate} = \frac{100 \times 365 \times 2\frac{1}{2}}{200 \times 73} = 5\frac{1}{2}$$

- (3) The 5 per cent. will not affect the ratios.

- (4) See Ex. 8, p. 152.

- (5) $\frac{£17480 \times 2\frac{1}{2}}{100} = £480 \text{ 14s.}$

$$\therefore £437 : £480 \text{ 14s.} :: 100 : 110$$

Now $110 - 100 = 10$ required rate.

- (6) Income from each share = £2

$$\therefore 100\frac{1}{4} : 32\frac{1}{4} } :: 280 \text{ 1st income} : 2\text{nd income}$$

$$£2 \times 240 : 365 \times 2\frac{1}{4}d. }$$

$$\therefore \text{Second income} = \frac{129 \times 365 \times 5 \times 280 \times 2}{4 \times 2 \times 240 \times 2 \times 240} = \frac{43}{67}$$

$$= £170 \text{ 16s. } 2\frac{2}{3}d.$$

$$\text{His loss} = £280 - £170 \text{ 16s. } 2\frac{2}{3}d. = £109 \text{ 3s. } 9\frac{1}{3}d.$$

- (7) Since $\cdot 9 = 1$, we have $\sqrt{378 \cdot 3025} = 19 \cdot 45$

$$\text{Again: } \sqrt{42 \cdot 03361} = \sqrt{42 \cdot 0336\frac{1}{3}} = \sqrt{\frac{378 \cdot 3025}{9}} = 6 \cdot 483.$$

$$\begin{array}{lcl}
 (8) & \text{Ans.} = 25.5 \text{ fr.} & \\
 & 117 \text{ fr.} = 55 \text{ fl.} & \frac{255 \times 55 \times 13}{110 \times 117} = 14\frac{1}{8} \\
 & 11 \text{ fl.} = 13 \text{ marks} & \quad \quad \quad \frac{2}{2} \quad \quad \frac{9}{9}
 \end{array}$$

$$\begin{aligned}
 (9) \text{ His gain} &= \left(\frac{75s. \times 101}{100} - \frac{75s. \times 96}{100} \right) \times 77 = (75s. 9d. - 72s.) \\
 &\times 77 = \text{£}14 \text{ 8s. 9d.}
 \end{aligned}$$

(10) This Question only differs from (6) H, p. 230, in one of the men resting every 10 miles. Both are worked alike.

(11) The faster train loses 30 miles travelled by the other in $1\frac{1}{2}$ hour, and 1 hour's travelling of itself, = 55 miles in all. Since it lost 10 miles an hour, $55 \div 10 = 5\frac{1}{2}$ hours' time gone after the accident.

$\therefore$ Length of line = $5\frac{1}{2} \times (15 + 20) +$ distance travelled before the accident = $35 \times 5\frac{1}{2} + 10 + 18 = 192\frac{1}{2} + 28 = 220\frac{1}{2}$ miles.

(12) This question can be worked out by comparing the maximum and minimum values.

O, page 237.

See LV., a specimen set of '39 sums' worked out.

P, page 238.

See LV., as above referred to.

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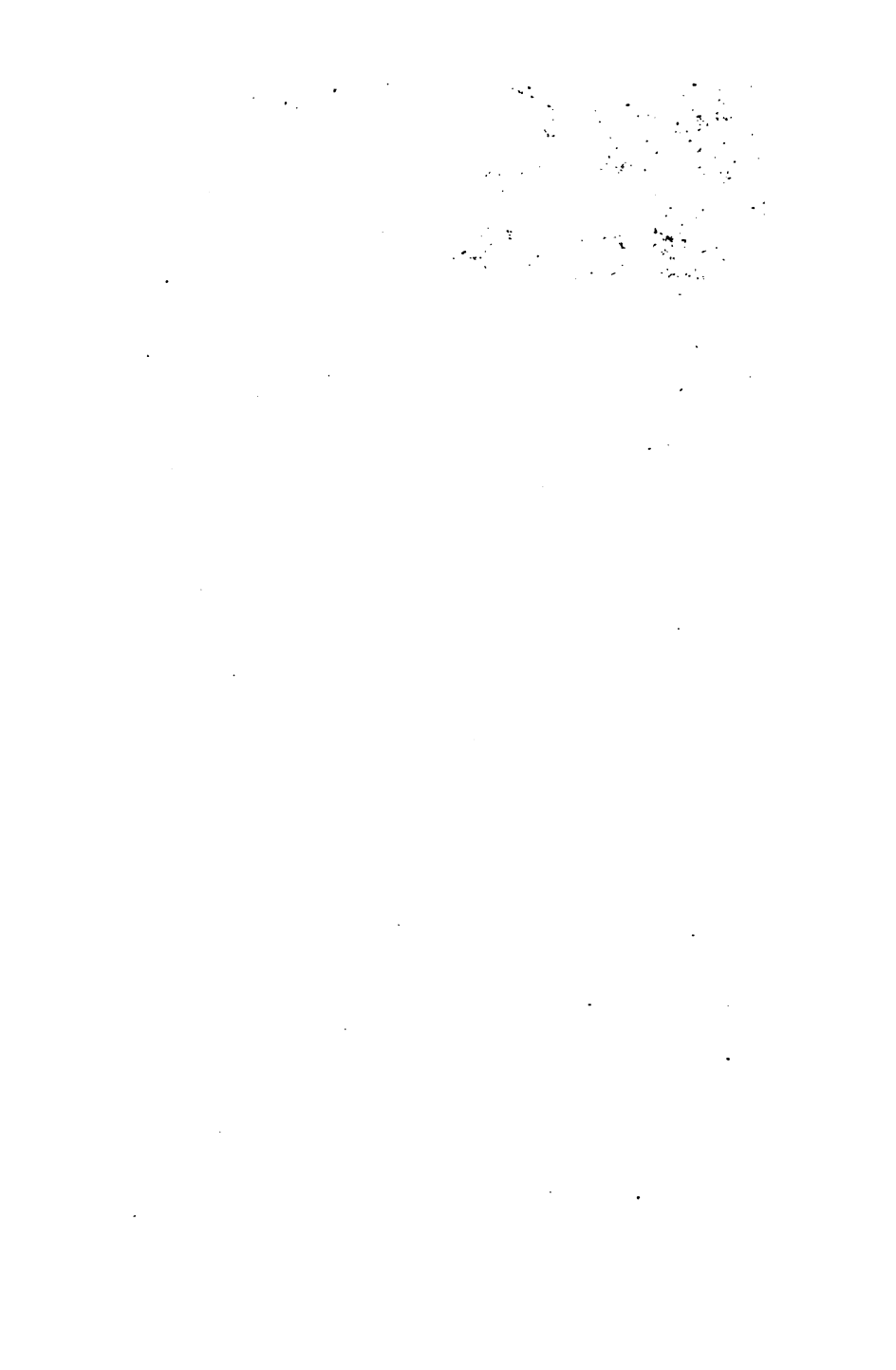
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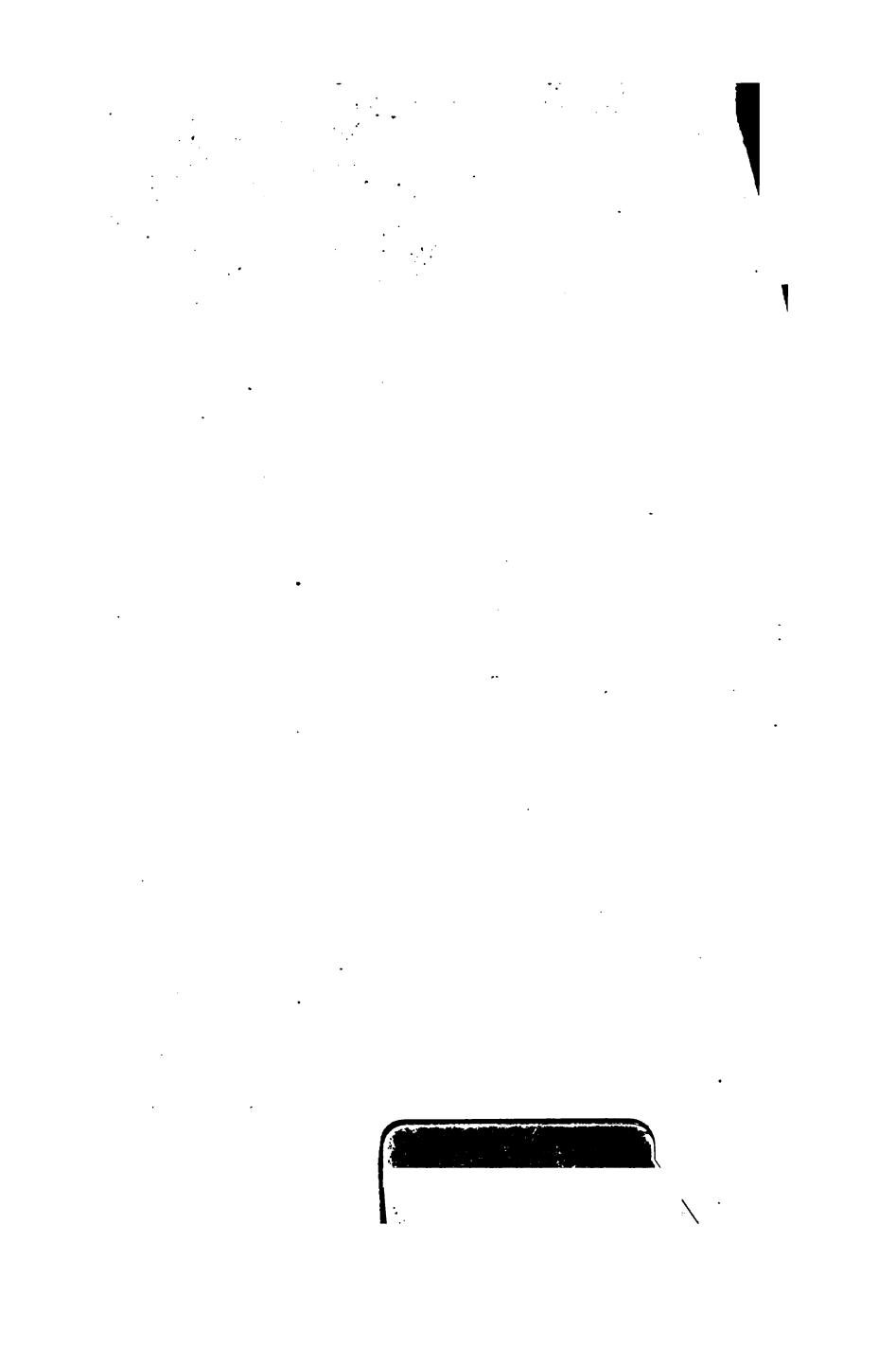


Figure 1

Ph. S. 100

Figure 1

100%

100

1000

[illegible]

1000

1000

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